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Online Video in the Future Internet Age: Business and Policy Dynamics

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"The internet does not exist.
Maybe it did exist only a short time ago, but now it only remains as a blur, a cloud, a friend, a deadline, a redirect, or a 404.
If it ever existed, we couldn't see it. Because it has no shape. It has no face, just this name that describes everything and nothing at the same time."

in Aranda et al. (2015).

Abstract

The convergence of the Internet with TV and film content is revolutionising the telecommunications, media and entertainment industries. But consumption habits are also in transition. TV viewing is no longer just about a TV-set in a living room, but is shifting to a *second-screen* or *multi-screen*, personalised and interactive experience with Internet connected devices sitting between the viewer and the TV. With an increasing number of services allowing viewers to watch either live or on demand TV content over the Internet, video consumption is transitioning to an anytime, anywhere, any device experience. In this context, this study challenges the 'OTT video' buzzword by considering a broader definition of video services delivered over the unmanaged Internet.

In this new environment, on the one hand, traditional media players are experimenting with new services and platforms in an attempt to adapt to and follow new players, while reinventing the dominant modes of video supply and protecting their content assets. On the other hand, other stakeholders such as ISPs, Internet players and CE vendors are also on the lookout to monetise their current resources and establish new direct customer relationships and walled gardens through online video services. With the strong dependence on the Internet for video distribution and the traffic demands and constraints video content would pose on network architectures, there is a growing concern about Internet's limitations among the research community. With this in mind, the Future Media Internet vision aims at realising the next generation of media and personalised content services, catering for efficient handling, delivery, presentation and protection of content. Crucial factors for media content delivery, such as high bandwidth, real-time, low delay transmissions, will demand for an architectural support for specific media content handling, as well as, a robust marketplace for innovation and alliances between media, telecom and Internet stakeholders.

This research is framed within a multidisciplinary approach combining innovation theory, political economy and strategic media management and intends to examine the potential impact of Future Internet technical transformations on the online video business ecosystem by deriving insights about the articulations of power and control in the dynamics behind technological change and market competition. The adopted methodology, informed by document analysis and expert interviews, contributes to characterise the current value network and control points arising between actors. Evidences demonstrate that control points in current online video services gravitate around a few actors, which impose limits on critical resources, create entry barriers for other actors, and hold more power in influencing or limiting other actors' activities. By focusing on gatekeeping functions, strategies and business dynamics employed by different actors and competitors are analysed and compared in business model configurations. The control points intertwined with triggers rooted in technology, business and regulation, allow for an exploration of several scenarios reflecting uncertainties related with content licencing processes and the customisation of quality of service at network or device level for video content delivery. For each scenario, the future dynamics of control and power positions and changes to the current business model configurations are uncovered.

Keywords: online video, online television, VOD, TV Everywhere, Future Internet, business models.

Resumo

A atual convergência entre a Internet e os conteúdos de televisão e cinema está a revolucionar as indústrias das telecomunicações, média e entretenimento. Consequentemente, também os hábitos de consumo estão em profunda alteração. O "televisionamento" em si está a evoluir do simples ato de ver um programa num televisor para uma experiência personalizada, interativa, com segundos ou múltiplos ecrãs, recorrendo a dispositivos ligados à Internet instalados entre o "telespectador" e a televisão. O crescente número de serviços de visualização de conteúdos ao vivo ou "on demand", torna possível o "consumo de vídeo" a qualquer momento e lugar, e utilizando qualquer dispositivo. Neste contexto, o presente estudo sugere uma definição mais abrangente de "OTT video" (*Over-The-Top video*), considerando que nela se deve incluir quaisquer serviços de vídeo fornecidos através da internet.

Neste novo ambiente, os atores de média tradicionais experimentam novos serviços e plataformas, numa tentativa de mimetizarem os novos atores, ao mesmo tempo que tentam proteger os seus ativos (i.e., conteúdos) através da redefinição dos processos de distribuição de vídeo. Simultaneamente, outros atores como fornecedores de serviço Internet ou fabricantes manifestam interesse em utilizar os serviços de vídeo em linha para monetizar os seus recursos atuais, estabelecendo com os utilizadores relações diretas ou *walled gardens*.

Esta nova forma de distribuição de vídeo é inerentemente dependente da Internet, e os requisitos que os conteúdos impõem sobre as redes de dados e suas arquiteturas suscitam na comunidade científica uma crescente preocupação com as limitações da Internet de hoje. A *Future Media Internet* visa a conceção de uma nova geração de serviços de média e conteúdos personalizados, baseada em novas formas de processamento, transporte, apresentação e proteção dos conteúdos. A existência de fatores técnicos críticos relacionados com a entrega de conteúdos (como a largura de banda ou atraso de transmissão) determina a necessidade das arquiteturas suportarem de forma nativa o processamento de conteúdos vídeo, bem como o desenvolvimento de um mercado robusto que fomente a inovação entre os atores dos sectores de média, telecomunicações e Internet.

Através de uma aproximação multidisciplinar que combina teorias da inovação, economia política e gestão estratégica dos média, discute-se o impacto que as alterações técnicas da "Internet do futuro" poderão ter sobre o ecossistema de negócio do vídeo em linha, e apresentam-se perspetivas sobre a articulação de poder e pontos de controlo relacionados com as alterações tecnológicas e de mercado. A metodologia utilizada caracteriza a rede de valor atual bem como os pontos de controlo emergentes, baseando-se não apenas na análise documental como também em entrevistas com representantes da rede de valor dos serviços de vídeo em linha. Demonstra-se em concreto que nos atuais serviços de vídeo em linha, os pontos de controlo gravitam em torno de um número reduzido de atores, que impõem limites na utilização de recursos críticos, criam barreiras à entrada de novos atores e têm a capacidade de limitar ou influenciar as atividades dos demais. A análise das dinâmicas e estratégias utilizadas pelos diferentes atores em várias configurações de modelos de negócio foca-se particularmente nas funções que lhes permitem obter e manter posições de controlo. A correlação dos pontos de controlo com estímulos de natureza tecnológica, de negócio e regulamentar, permite a definição e exploração de diferentes cenários que, não obstante, incorporam incertezas relacionadas com os processos de licenciamento de conteúdo e o controlo da qualidade de serviço associados ao fornecimento de conteúdos de vídeo em linha. Para cada cenário, abordam-se as dinâmicas futuras de poder e posições de controlo, bem como de novas configurações dos modelos de negócio.

Palavras chave: vídeo em linha, televisão em linha, *VOD*, *TV Everywhere*, Internet do Futuro, modelos de negócio.

Samenvatting

De convergentie van internet met televisie en film is de telecommunicatie-, media- en entertainmentsectoren op een revolutionaire manier aan het transformeren. Consumptiegewoonten veranderen echter ook. Televisie kijken gebeurt niet enkel meer op een tv-set in de woonkamer, maar verschuift steeds meer naar een *tweede scherm* of meerdere schermen, waar een gepersonaliseerde en interactieve ervaring gerealiseerd wordt door middel van met het internet geconnecteerde apparaten. Met een toenemend aantal diensten die het voor de kijker mogelijk maken om live of uitgesteld televisiecontent over het internet te bekijken, is videoconsumptie aan het veranderen in een nieuwe gebruikservaring waarbij "op ieder moment, op iedere plaats en op ieder apparaat" het devies is. Gezien deze context, betwist deze studie het *buzzword* 'OTT (Over-The-Top) video' door een bredere definitie van videodiensten over het ongecontroleerde internet te beschouwen.

In deze nieuwe situatie experimenteren de traditionele mediaspelers met nieuwe diensten en platformen naar het voorbeeld van nieuwe spelers, en proberen ze tegelijk de dominante methoden van videoaanbod te heruitvinden en de content die ze bezitten te beschermen. Aan de andere kant ziet men dat andere belanghebbenden, zoals internetproviders, internetdienstverleners en consumentenelektronicamerken ook op zoek zijn naar manieren om hun bezittingen te gelde te maken, nieuwe klantenrelaties op te bouwen en consumenten te vangen binnen een zogenaamde *walled garden* (een gesloten ecosysteem) door middel van hun online videodiensten.

Omdat videodistributie een steeds sterkere afhankelijkheid van het internet heeft, met daarmee gepaard gaande hoge eisen die het aan netwerkarchitecturen stelt, is er een groeiende zorg binnen de onderzoeksgemeenschap over de beperkingen van datzelfde internet. Met dit probleem in het achterhoofd is de *Future Media Internet*-visie ontwikkeld, die zich richt op de nieuwe generatie van gepersonaliseerde mediadiensten waarbij zorg wordt gedragen voor de efficiënte afhandeling, bedeling, presentatie en bescherming van content. Cruciale factoren voor de bedeling van mediacontent, zoals aflevering met hoge bandbreedten, in *real-time* met zo klein mogelijke vertragingen, vereisen een architectuur die ondersteuning biedt voor specifieke mediahanteringen, voor een robuuste innovatiemarktplaats en voor samenwerking tussen belanghebbenden, te weten de media, telecom en internetspelers.

Dit onderzoek is gebaseerd op een multidisciplinaire aanpak die innovatietheorie, politieke economie en strategisch mediamanagement combineert. Met dit raamwerk wordt de potentiële impact van technologische transformaties (specifiek het zogenaamde *Future Internet*) op het bedrijfsmatig ecosysteem van online video bestudeerd door een analyse van de concepten 'macht' en 'beheersing' in de dynamieken achter technologische verandering en marktcompetitie. De voorgestelde methodologie, op basis van documentanalyse en experteninterviews, kenschetst het huidige waardenetwerk en de machtspunten die ontstaan tussen spelers. Er wordt aangetoond dat bij de huidige onlinevideodiensten de machtspunten zich concentreren bij enkele spelers, die toegang tot essentiële middelen beperken, toetredingsbarrières voor nieuwe spelers opwerpen en machtsmiddelen hebben om de activiteiten van andere spelers te beïnvloeden of beperken. Strategieën en dynamieken van verschillende spelers en hun concurrenten worden geanalyseerd en vergeleken in verschillende

businessmodelconfiguraties, met een speciale aandacht voor zogenaamde ‘poortwachtersfuncties’ (*gatekeeping*). Door kennis over deze machtspunten te combineren met indicaties uit technologie, bedrijfsleven en wetgeving, worden verschillende scenario’s verkend met betrekking tot contentlicentieprocessen en gebruiker-specifieke kwaliteit van de dienstverlening (*Quality of Service*) op het niveau van het netwerk of het apparaat voor videocontentaanlevering. Voor ieder scenario worden de toekomstige dynamieken van beheersing en macht en de daaruit volgende veranderende businessmodelconfiguraties blootgelegd.

Trefwoorden: online video, online televisie, *VOD*, *TV Everywhere*, *Future Internet*, businessmodellen.

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The idea for the research topic of this thesis emerged from my involvement in several European research projects focused on topics related with Future Internet architectures and technologies. Since 2008, I participated in business modelling research at the Centre for Studies in Media, Information and Telecommunications (SMIT) of the Vrije Universiteit Brussel (VUB), part of iMinds (formerly the Interdisciplinary Institute for Broadband Technology (IBBT)), mostly revolving around the impact of Future Internet technologies on the telecommunications sector. Amidst the great "bubble" around this topic in European research and experimentation, I felt the urge to expand my horizons and study the potential impact of Future Internet on digital media services. Above all, with my background in IT and telecommunications, what I really wanted was to study and explore the media sector, all its intricacies, and differences and similarities with the telecoms/Internet sector.

I am thus grateful to my supervisors at University of Porto and Vrije Universiteit Brussel, Prof. Artur Pimenta Alves and Prof. Pieter Ballon, and co-supervisor Prof. Joana Resende, for believing in this research topic and constantly supporting me throughout the completion of this thesis. I am also dearly indebted to Prof. Caroline Pauwels, director of SMIT, for the opportunities she granted me, firm support and encouraging words, and believing I could pursue this work between two cities — Porto and Brussels.

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List of Abbreviations and Acronyms

3DTV	3D Television
3G	3rd (cellular) Generation
4G	4th (cellular) Generation
ABR	Adaptive Bitrate Streaming
API	Application Programming Interface
AVMS	Audiovisual Media Services Directive
AVOD	Advertisement-supported VOD
BMCM	Business Model Configuration Matrix
CAPEX	Capital Expenditures
CDN	Content Delivery Network
CE	Consumer Electronics
DAN	Data Aware Networking
DPI	Deep Packet Inspection
DRM	Digital Rights Management
DSL	Digital Subscriber Line
DTO	Download to Own
DTR	Download to Rent
DTT	Digital Terrestrial Television
DVD	Digital Versatile Disc
DVR	Digital Video Recorder
EST	Electronic Sell Through
FCC	Federal Communications Commission
FCN	Future Content Networks
FI	Future Internet
FIA	Future Internet Assembly
FMI	Future Media Internet
FMI-TF	Future Media Internet Task Force
FMIA-TT	Future Media Internet Architecture Think Tank
FN	Future Network
FP7	European Framework Programme 7
FTC	Federal Trade Commission
FTTH	Fiber To The Home
HD	High Definition
HDMI	High Definition Multimedia Interface
HHI	Herfindahl–Hirschman Index
HLS	HTTP Live Streaming
HTML5	HyperText Markup Language 5
HTTP	Hypertext Transfer Protocol

ICT	Information and Communication Technologies
ICTS	Information and Communication Technologies and Services
IP	Internet Protocol
IPR	Intellectual Property Rights
IPSEC	IP Security
IPTV	Internet Protocol Television/TV over IP
IPv4	Internet Protocol version 4
ISP	Internet Service Provider
IT	Information Technology
IXP	Internet Exchange Point
LTE	Long Term Evolution
M&A	Mergers and Acquisitions
MANE	Media Aware Network Element
MPEG-DASH	MPEG Dynamic Adaptive Streaming over HTTP
MPEG-TS	MPEG Transport Stream
MVC	Multi-view Video Coding
MVCE	Mobile Virtual Centre of Excellence
NAT	Network Address Translation
NGN	Next Generation Network
OPEX	Operational Expenditures
OS	Operating System
OSS	Operational Support Systems
OTT	Over-The-Top
OVP	Online Video Platform
P2P	Peer-to-peer
PC	Personal Computer
PVR	Personal Video Recorder
QoE	Quality of Experience
QoS	Quality of Service
R&D	Research and Development
RTCP	RTP Control Protocol
RTP	Real-time Transport Protocol
SDO	Standards Development Organisation
SDK	Software Development Kit
STB	Set-top box
SVC	Scalable Video Coding
SVOD	Subscription Video on Demand
TCP	Transmission Control Protocol
TR	Technical Report
TVE	TV Everywhere
TVOD	Transactional Video on Demand
UDP	User Datagram Protocol
URL	Uniform Resource Locator
VCDWG	Value Chain Dynamics Working Group
VOD	Video on Demand

Chapter 1

Introduction

1.1 Context

Traditional media predominantly operated under vertically integrated conglomerates, monopolising services, and controlling and influencing content production. Content was scarce, designed for mass appeal and to reach the widest possible audience. Media industries often relied on revenue streams from content consumption and from advertising. Thus, media players were often regarded as gatekeepers of all media processes, from content production to supply, while imposing high barriers for competition.

As media industries strongly depend on technology, they are therefore affected by major technological transformations. Over the past decades, dramatic improvements in information and communication technologies and services (ICTS) have contributed to change the way content is generated and disseminated as well as to change the way firms and markets operate and economies develop (Melody, 2007). Digitisation, although a distinct development, is tightly connected with the advancement of ICTS. Digitisation has transformed the delivery of virtually all media products (Küng et al., 2008) and contributed to change many media processes, from content production to distribution and reception. Content production costs were reduced and packaging and distribution have been highly facilitated by the introduction of content management and distribution platforms. Digitisation has also contributed to massively increase the volume of media content offerings, lower technology-based entry barriers, reshape media markets and transform competition (Doyle, 2013).

Both the digitisation and the Internet are having a significant impact on the supply and consumption of media. In this study, the focus lies on online video services and online video distribution. Throughout this study online video services refer to generalised video delivery of professional content using the Internet Protocol (IP) over a public network, i.e. the Internet, and three types of distinct services are considered — Video on Demand, live and catch-up linear TV, and TV Everywhere.

We can identify two waves of Internet development and its impact on online video services. The first, which refers to the current situation, wherein the Internet architecture and capabilities are reaching its limitations and online video consumption is getting to a level of massification and causing great impact on the development of the media, telecom and Internet industries. The second wave refers to the Future Internet, to a number of research initiatives aiming at tackling several business and technological bottlenecks experienced in the current Internet.

1.1.1 First Internet wave and its impact on online video services

The Internet has been presented to the media sector as a new distribution channel with no geographical or reception limitations and therefore enabling the emergence of new services and markets. While at first the media sector was not ready for such technological innovations and was unable to cope with the first innovators (Cunningham and Silver, 2013), online video consumption is now reaching a level of massification and causing great impact on the development of the media and content industries and media-related services.

At an early stage of video deployment over the Internet, consumption was confined to the personal computer or laptop. Over the past decade, we are seeing a number of new devices emerging — digital media hubs, game consoles, DVRs, DVD and Blu-ray players — and serving as interfaces between the content available online and the TV-set (Marinelli and Andò, 2014). And although user generated video has been tremendously popular over the past decade, to which YouTube growth and scale has much contributed, viewers are increasingly consuming professional content online, even if in some instances this means unauthorised consumption through peer-to-peer (P2P) file-sharing networks. Many disruptive innovations and platforms are contributing to the growth of online video consumption (Cunningham and Silver, 2013). For example, Apple TV or Roku devices allow the viewer to access iTunes store or Netflix Video on Demand (VOD) content directly on TV's screen. Sony DVD and Blu-ray players support streaming content from VOD platforms such as Hulu or Amazon Instant Video as well as directly from Web pages with a built-in Web browser (Vaughan-Nichols, 2011). Smart TVs also add up to the convergence trend between computers and TV-sets. These devices have integrated Internet-access capabilities and, among others, enable access to on demand and catch-up TV services.

The changes in content consumption and in digital distribution triggered traditional media players to experiment with new services and platforms in an attempt to adapt to and follow new Internet players, although trying to replicate previous business models and main strategies. Pay-TV operators' TV Everywhere services are an example of an anytime, anywhere experiment which, however, does not let the viewer leave the walled garden of a pay-TV subscription. In the same way, studio-based content providers launched their own platforms, such as Movielink and Sony's Crackle, which, despite the great amounts of content available, have not generated the same interest as Netflix or Amazon Instant Video. Furthermore, broadcasters have been slower to embrace the online anytime, anywhere paradigm, BBC being one of the few exceptions to this. Key factors slowing this adaptation are in most cases not considering online distribution as part of the overall strategy of TV distribution, legacy technology and lack of financial funds. But in this transformation, the ones owning crucial infrastructure that delivers digital content, such as ISPs, are also on the lookout to monetise their "pipes" and find ways to charge extra for efficiently delivering media content. Although many of these online video services use and combine different business models and distribution routes to reach the audience, several of the stakeholders involved are in many instances competing and cooperating at the same time, with the ultimate goal of monetising resources as fully as possible. The traditional two-sided media market, with advertising revenues being one of the great sources of revenue for media players such as broadcasters, undergone significant alterations in the Internet model. Advertising is now intermediated by brokers, typically Internet players such as Google, reducing the importance of the advertising revenue for media players.

Overall, one could claim that the Internet is disrupting the current ecosystem of video in many ways: removing barriers to distribution, thus generating an abundance of "free" content; lowering expectations for monetisation, as consumers typically expect everything to be free; changing consumer habits, undermining the share of time that viewers dedicate to other media. With such great abundance of content, devices and access technologies, the media sector has increasingly become aware of the importance of controlling key access points or resources, which are prone to monopolisation, along the media value chain. The widespread of different services and supporting technologies has stimulated competition amongst players and shaped market demand towards the acceptance of online viewing. Right now, online video services are experiencing an explosive take-off and growth, as a critical mass willing to pay for these services is developing. Innovation is on a fast pace, with new services being launched, new models of content funding being experimented, and new devices and models of engagement embracing Internet connectivity being developed. Also, several firms are exploring verticalisation and service desintermediation strategies[1] in order to control strategic resources in the value network and to conquer a market share of the online video hype.

However, the Internet, in terms of connected users and geographical spread, is growing at unexpected rates. Global Internet Protocol (IP) traffic on fixed and mobile networks has increased more than fivefold in the past 5 years, and will increase threefold over the next 5 years, with traffic from wireless and mobile devices expected to exceed traffic from wired devices by 2018 (Cisco, 2014). Consumer traffic has been driven in large part by high bandwidth demand services, with Internet video alone representing 66 percent of consumer Internet traffic in 2013 and expected to increase to 79 percent by 2018 (Cisco, 2014). From the perspective of the telecom world, Internet Service Providers are being forced to invest in upgrading and expanding infrastructure, resulting in raising capital and operational expenditures (CAPEX and OPEX). However, they claim they are not obtaining sufficient return on the investments since they are generally excluded from revenue sharing that takes place between content providers and application service providers. This has triggered many operators to embark in strategies of traffic management[2] and premium services looking for additional sources of revenue. These practices have intensified the debate over network neutrality and generated tensions between application service providers and content providers, who argue that certain users or applications should not be favoured over others, and operators, who suggest that pricing/service differentiation and traffic management mechanisms need to be in place

[1]In verticalisation, firms incorporate several (vertical) activities related with its core business, which were traditionally taken up by other firms, either by adding those activities to their business or by acquiring other firms. For example, a content distributor acquires a content producer in order to have privileged access to content. With service desintermediation strategies, firms establish a direct relation with consumers without passing through other providers or intermediaries.

[2]One of the most discussed traffic management cases relates to Comcast practices of blocking peer-to-peer traffic. Weitzner (2008) discusses the Comcast incident and the connections to net neutrality, while Jordan (2009a) examines whether traffic management practices are reasonable.

to improve profitability, efficiency and innovation[3].

However, these investments in infrastructure only provide extra capacity, but do not respond efficiently to an increasing demand for performance, availability, security, and reliability, which go beyond the original design objectives of the Internet (Zahariadis et al., 2011). The Internet is progressively reaching a set of fundamental technological limits and is being impacted by its operational limitations (FMI-TF, 2010). While some of the limitations could be addressed by "over-dimensioning" capacity and enhancing certain Internet capabilities, that would solely represent a transitional solution, which would not be able to later respond to the deployment of new applications and services with qualitative requirements such as e-health applications and immersive and 3D multimedia experiences (Zahariadis et al., 2011). These challenges have motivated several research initiatives worldwide to search for structural changes to the current Internet architecture, which could respond to the new requirements. This forms the basis of a new wave of the Internet, the Future Internet.

1.1.2 Second Internet wave: Future Internet

In the quest for solutions to overcome current technical limitations, research initiatives argued for the concept of Future Internet, defined as a number of structural changes which would be able to tackle several business and technological bottlenecks experienced in the current Internet.

Two approaches are being considered in order to make the Internet move forward. On one side, many believe that Internet's original architecture has already shown the capability to adapt to new services and applications and therefore the same approach of solving problems as they emerge should continue to be pursued, provided that backward compatibility and incremental deployment is ensured (Rexford and Dovrolis, 2010; Dovrolis, 2008). This is considered to be the evolutionary or incremental approach. On the other side, some argue that current Internet's challenges can only be solved through rethinking the fundamental goals and design principles underlying its architecture through a clean-slate approach[4] (Talbot, 2005; Feldmann, 2007). Hence, clean-slate research aims to design a new 'Future Internet' architecture that will tackle known problems and bottlenecks of the

[3] For further details about the net neutrality discussion see Economides and Hermalin (2012); Hahn and Wallsten (2006); Jordan (2009b).

[4] Feldmann (2007) defines clean-slate as the way a system is redesigned from scratch to offer improved abstractions and/or performance, while providing similar functionality based on new core principles.

current Internet, without being constrained by the architecture or protocols currently used (Rexford and Dovrolis, 2010).

The clean-slate approach to redesign the Internet gained momentum in the last years through several research activities and experimental facilities spread across the U.S., Europe, Japan and Korea. These research activities have been actively contributing to several Standards Development Organisations (SDOs) such as IETF[5], ETSI[6], W3C[7] and IEEE[8] on specific technical topics and advancements. At the same time, international organisations ISO/IEC[9] and ITU[10] have been independently developing a high-level vision of the Future Internet aiming at defining the concept of Future Network (FN), its objectives and design goals. Although the two views essentially describe technical limitations and future requirements, environmental, social and economic issues are also taken into account. The latter factors address energy savings at equipment and system-levels, Internet's universal access, and social and economic sustainability of future networks. Moreover, both proposals specifically outline the need for networks to become more content-aware in order to fully comply with service and user requirements and to efficiently handle media content distribution. Both organisations have set 2015-2020 as the targets dates to have standards in place and technology ready to be widely deployed.

With these potential technological developments in sight, which impact can be expected for online video services, the dynamics around their value network and the relationships between actors pertaining to the media, telecom and Internet sectors? This is the central question of this study which aims to study the future of online video services in case Future Internet technical capabilities reach market deployment.

1.2 Research Objectives

The research objectives of this study are twofold. The first objective refers to the first Internet wave and impact on online video services, and concerns the characterisation of the current value network

[5]The Internet Engineering Task Force.
[6]European Telecommunications Standards Institute.
[7]World Wide Web Consortium.
[8]Institute of Electrical and Electronics Engineers.
[9]International Organization for Standardization and International Electrotechnical Commission.
[10]International Telecommunication Union. ITU-T is the ITU specific sector dealing with standardisation.

of online video services regarding its business roles, actors and stakeholders and the identification of control and power positions among actors.

In this thesis, the conceptualisation of value network is used and preferred to the value chain concept, as the latter became increasingly inappropriate to analyse industry sectors and the dynamics of value creation, co-operative behaviour and inter-firm relationships (Nielsen, 1988; Normann and Ramirez, 1993). In value networks, value creation is established by the relationships between firms and the competitive environment arising from the network of relationships (Anderson, 1995). In the context of this study, value networks are examined in terms of value streams (service and financial flows) between a set of abstracted entities. These entities include business roles, actors and stakeholders. A business role is a discrete set of responsibilities, actions, activities and authorisations that together have a coherent value-adding logic. A business actor is an active marketplace entity, which integrates one or more roles. A stakeholder can be defined as a current real-life organisation (a specific individual, institution, company, etc.) with an interest or stake in the outcome of a certain action (Ballon et al., 2008). In the context of value creation, the concept of business model in a multi-firm environment emerges as the way to capture value and its activities within a product or service by linking new technological environments to business strategies (Hawkins, 2004), but also to capture who controls value creation and system design (Chesbrough, 2006; Ballon, 2007). In a technological driven environment, multiple revenue streams for the same technology are often simultaneously developed, hence constituting several configurations of business models.

In order to study control and power issues between actors, this thesis adopts the concept of control points. According to Trossen and Fine (2005), a control point is defined as an element at which control can be exercised, enabling an actor to demonstrate influence over other actors in the value network. Control can be exercised on a control point through business, regulatory, and/or technical means. Essentially control points enable an actor to exercise power over other actors in the value network.

The second objective of this study addresses the second wave of Internet development, takes the perspective of the prospective developments and deployments of Future Internet and Future Media and aims at uncovering potential evolutions of the value network and the dynamics of power and control relationships.

In the pursuance of these objectives, four research questions are formulated. Taking the perspective of recent Future Internet and Future Media research and standardisation developments, the first research question asks:

(RQ1) How are the technical requirements of the media business stakeholders being accommodated by FI design and standardisation activities?

Further on, and assuming these technological changes aiming at improving media distribution and performance are soon to move from research to market deployment, this study aims at identifying how the online video sector may be impacted. Notwithstanding the fact that, in this case, technology may be the trigger for change, business, regulatory and social factors which may disrupt the current state of the sector need also to be brought into the picture. These factors may cause changes in business models (on the micro level) and changes in the industry's value network (on the macro level). They can also affect the dynamics of control points, in particular on how these might change over time or on how the economic power they carry may transition to other states or actors. In order to capture these factors and how online video services may be impacted in the future, additional research questions are formulated:

(RQ2) Which factors may affect the dynamics of control and power positions between actors?

(RQ3) Which new business model configurations could emerge?

(RQ4) Which potential future policy and regulatory changes could help balance actors' relationships?

1.3 Literature overview and relevance of this study

Scholars have been studying the economics and business strategies of video distributed over the Internet through various perspectives, notably focusing in specific case studies, or on how the Internet is changing business models and management strategies in the media and entertainment industry as a whole, but frequently neglecting the intricacies of Internet distribution and related actors.

Gomery (2004) and Pardo (2012, 2013) have specifically focused on the economic power of Hollywood studios, key transformations and challenges, and the quest for the right business model. Both Hutchins and Rowe (2009) and Blain (2010) analysed the emerging conflicts between the sports and media industries as sports content shifts from linear TV to the online environment.

Artero (2010) studied the origins and development of YouTube and Hulu and compared the business models and strategies of both services, while Cunningham and Silver (2013) provided a thorough and updated account of the history and transformations of online video services, with special focus on VOD, and analysed the strategies of industry leaders such as YouTube, Hulu and Netflix. Fontaine et al. (2010) developed three alternative scenarios for the migration of the television industry to the Internet. Baccarne et al. (2013) assessed the evolution of over-the-top services in Flanders in a context of high pay-TV penetration, while Marinelli and Andò (2014) focused on the roles of multiscreening and social TV in the transformation of TV consumption experience in Italy.

Wirtz (1999, 2011); Dowling et al. (1998); Liu and Chan-Olmsted (2003); Chan-Olmsted (2004); Daidj (2011); Picard (2003); Arsenault and Castells (2008) have taken a strategic management perspective and analysed the transitions in the media industry as a whole, e.g. mergers, acquisitions, partnerships, as a result of digitisation and the process of convergence between media and ICT industries.

Ulin's (2014) recent book focuses on the business of film, TV and video content distribution and describes thoroughly market conditions, strategies, business models, opportunities and challenges in theatrical, home video, TV and Internet distribution. For Internet distribution, the scholar gives an exhaustive account of the relationships between content creators, studios, advertisers, old players and new players, while also acknowledging the importance of apps and devices for content consumption. However, the roles and strategies played by ISPs and their relationships with content providers and other players in the value network are generally ignored.

Most studies that highlight the relationships between content providers and ISPs or between online video service providers and ISPs in Internet distribution also underline the key role of these players in the value network for online video distribution. However, such studies primarily focus on net neutrality issues related to video distribution (Nooren et al., 2012; Pil Choi and Kim, 2010; Odlyzko, 2008) or in emerging data caps issues affecting video content consumption, especially in the U.S.. Minne (2013) examined the power relationships established by ISPs when imposing user data caps and explored alternatives for regulatory action. Minne also provides a short and comprehensive overview of Internet's interconnection agreements to inform the discussion on data caps. From a network perspective, Ha et al. (2008) and Ma et al. (2010) focused on the economics of Internet video distribution, comparing cost characteristics and providing cost models for content delivery networks and peer-to-peer networks. In their turn, Frank et al. (2013) focused on technical opportunities and incentives for content providers, CDNs and ISPs to collaborate in order to improve content delivery. While taking a broader understanding of all the actors in the ecosystem, Montpetit et al. (2010), provided a broad understanding of the market conditions, from content production to device consumption, but in the context of mobile TV and its possible evolutions.

Furthermore, literature that addresses innovation and digital transformation around online services focuses on the conceptualisation of value chains (Nooren et al., 2012; Rangone and Turconi, 2003; Gimpel, 2015), instead of value networks. For instance, Rangone and Turconi (2003) provided an early account of the impact of new technological trends on traditional TV. They analysed not only the impact on digital services, but also the emerging value chain, new suppliers and potential entrants in TV-related online multimedia services. Moreover, on the one hand, literature on innovation around online video fails to address potential evolutions of the Internet architecture, not only as a prerequisite for online video's growth, but also to address the increasing congestion and video traffic growth, and the consequent impact of those evolutions on incumbent actors. On the other hand, literature describing the Future Internet and Future Media technological developments (e.g. content centric networks) neglect the potential impact on the structure of the online video market. Although the emergence of new business models is recurrently acknowledged (Alduán et al., 2012; Zahariadis et al., 2011), it is also understudied. A preliminary perspective on the socio-economic aspects which might shape the Future Internet was given by Hausheer et al. (2009), while Trossen and Kostopoulos (2012) concentrated on socio-economic aspects of future information centric networks. While acknowledging the need to address business modelling studies in European Future Internet research, Gonçalves et al. (2011) provided a high-level overview of those activities in European-funded projects.

Power relationships, competition issues and regulatory measures are emerging issues in the study of online video services. Sherman et al. (2014) explored the economics of online video industry in the U.S. and identified potential obstacles to its future growth (e.g. competition and competitive advantage of pay-TV operators and TV Everywhere services) and how can regulation help overcoming those obstacles. Waterman et al. (2013) focused on the economic analysis of the "online television industry", including services such as Netflix, Amazon, Crackle, YouTube, and offered an overview of the incentives of pay-TV operators to offer TV Everywhere services. Evens (2013) analysed the impact of digitisation and convergence on industry structures and the emergence of value networks and platforms controlled by incumbents from offline video and new online players. Later on, Evens (2014) complemented this study by focusing on TV broadcasters co-opetition practices to enter the online video market, specifically on how TV broadcasters have collaborated with their closest competitors to reduce costs and reach the necessary scale in the online video business ecosystem. Cunningham and Silver (2013) questioned how emerging powerful players, outranking content producers and distributors, seek to pursue market power strategies in order to limit competition and lock consumers behind walled gardens. The recent book by Curtin et al. (2014) allows for a good reflection on the dynamics of digital delivery services through a collection of interviews with leading executives at Hollywood studios, online video firms and content creation and production firms. The focus is thus essentially on the media sector or relationships within the media industry, ignoring the providers of the distribution infrastructure.

To summarise, there are a number of gaps in existing literature. Although online video services are receiving increasing attention from scholars and concepts and terminology around online video services are converging towards common terms, studies fail to encompass a broader view of the market and all the actors that contribute to the creation of value or to the introduction of bottlenecks in service provision. This study contributes to the understanding of this market with an empirical study of the dynamics of online video services value networks, adding further granularity to the value network and identifying the diverse actors in content, distribution, application and device provisioning. In this broader context, issues of power and control are discussed for the current context and also in alternative future scenarios, which will encompass, among other factors, Future Media technological evolutions. At the current immature state of online video services, this study contributes to the identification of a taxonomy of online video services, differentiating TV Everywhere, VOD, and live and catch-up linear TV, all delivered over the unmanaged Internet.

Ultimately, this study does not predict the future of online video services (nor the future of television), but does provide an empirical end-to-end overview of the state of services providing professional video content over the Internet and identifies some of the transformative pressures affecting its evolution. In this end-to-end overview, supporting services such as (client-side) analytics or advertising, which contribute to content and service's monetisation, are considered in a simplified way. Although is clear that online video services and the media sector in general depend on revenue generated from advertising, this study has chosen to focus primarily on the activities concerned with delivering content and video services to the consumer through the Internet. Analogously, this study does not intend to study the impact of piracy on the future development of online video services. The focus is primarily on commercial legal services, therefore piracy-related issues have been substantially neglected. Finally, while overviewing the current state of online video services, although services from Europe and the U.S. are considered, the focus leans slightly more to U.S.-based services, as there is more public information widely available.

1.4 Thesis outline

Following this introduction, Chapter 2 discusses the theoretical guiding principles of this study. Concepts and assumptions arising from innovation theory, political economy and strategic management literature are overviewed in order to present the motivations for a multidisciplinary framework to address the potential impact of Future Internet on online video services. The proposed rationale intends to highlight the interrelationships between technology, institutions, markets and policies.

Chapter 3 presents the methodological approach, based on qualitative analysis, bringing together a methodology which combines business modelling and value network analysis, an iterative process of desk research and interviews, the identification of control points and business model configurations, and the outline of future business scenarios for online video services.

In Chapter 4, an analysis of the current market state of online video services and emerging disruptions happening in this field are presented. This analysis is primarily focused on services available in the U.S. and in Europe. In addition, a generic value network of online video services is outlined, resulting from input collected in in-depth expert interviews. This chapter concludes with a taxonomy of online video services, as part of the first step of the adopted methodology.

Chapter 5 delves deeper into the value network identified in the previous chapter and, based on in-depth expert interviews, enumerates control points rooted in technology, business and regulation. Through six gatekeeper roles, a number of business model configurations are presented and analysed centred on different actors holding service provision — online video aggregators, content producers and rights holders, CE vendors, Internet players, pay-TV operators, and broadcasters.

Chapter 6 provides an overview of the limitations of the current Internet and presents research and standardisation initiatives being developed addressing the evolution of the Internet. In particular, ITU-T and ISO/IEC standardisation activities on Future Internet or Future Network are overviewed. Moreover, ITU-T and ISO/IEC specific media standardisation activities, as well as European Future Media Internet initiatives are discussed. Finally, this chapter answers the first research question and identifies technology triggers as input to the Future Media Internet scenarios to be outlined in the following chapter.

In Chapter 7, the last steps of the methodology and the remaining research questions are addressed. This chapter focuses on the future of online video services by highlighting a number of technical, regulatory, business and social triggers which may disrupt the current state of the business and hence impact the dynamics of current control points. Using as a basis an empirical analysis of the impact of these triggers on the future development of online video services and their importance to business actors, two uncertainties are derived to construct four Future Media Internet scenarios for the future of online video services. A number of policy and regulatory considerations are put forward to address potential imbalances in the market and between actors.

Finally, Chapter 8 presents the main theoretical, methodological and empirical findings. In addition, research limitations are discussed and considerations for future work are envisioned.

Chapter 2

Theoretical framework

This chapter introduces the theoretical background of this thesis, which is at the crossroads of technological and institutional change, economics, communications studies and management (Figure 2.1). Contemporary developments in media, telecommunications and Internet sectors have not only been influenced by technological changes but have also been strongly influenced by economic forces and strategic choices. Thus one cannot isolate one or another sector and neglect the interaction between them. It is necessary to assume that these industry sectors instigate complex and dynamic economic systems. In this thesis, as a baseline, I have turned to innovation theories grounded in evolutionary economics and in specific to innovation and techno-economic change theories towards the goal of characterising a framework which considers the interrelationship between technology, institutions, markets and policies in order to frame and answer the research questions. While economic characteristics of the media, networks and Internet derived from media economics, media management, network economics and Internet economics are useful to understand general business motivations in converging sectors, this thesis adopts an overall perspective of political economy of communication in order to address issues of power and market dominance which are underestimated by innovation theories. Furthermore, strategic media management provides the background to understand and characterise current market trends and strategic responses of media, telecom and Internet firms to technological change. Especially with Internet services and over the past years, the nature of competition has changed: from a strong focus on price competition to a higher emphasis on delivering more value to customers. Therefore, towards this goal firms are putting more effort in achieving strategic partnerships that could benefit their economic growth, decrease costs, increase the range and quality of services provided and increase their customer base.

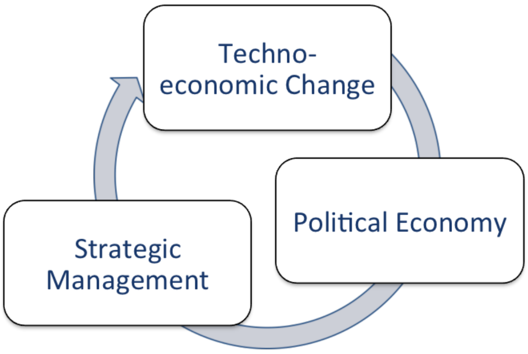


Figure 2.1: Theoretical multidisciplinary approach.

Although this study can be broadly described as techno-economic, there is no intention to enrich it with a mathematical approach and yet another neoclassical equilibrium analysis. Neoclassical economic theories usually assume that firm behaviour is described by profit maximisation with a focus on static market equilibrium, the rational allocation of scarce resources, and costless market business transactions. Dynamic environments, technological change, uncertainty about the future economic environment, the role of institutions, and transaction costs are traditionally neglected factors (Aghion et al., 1998; Silva et al., 2004). In contrast, evolutionary theories tend to explain the processes of technological and institutional innovation with an emphasis on dynamic markets and imperfect competition. Therefore, evolutionary tools are less mathematical-based and tend to be more qualitative and exploratory. Reinert and Riiser (1994) summarise well the differences between the two approaches (Table 2.1). Evolutionary economic approaches focus on the concept of institutions and the role of institutional change in encouraging economic activity as well as on the role of technology as an agent of change, under imperfect market conditions with substantial variations in market power (Mansell, 1993). In addition, as neoclassical theories fail to incorporate the specifics of changing technology in each period of time, evolutionary theories make an effort to incorporate time and historical perspectives and effects (Nelson and Winter, 1982). The focus is then on the relationship between innovation and institutions and ways in which creation and diffusion of new technologies is facilitated or hindered by the prevailing combination of social, economic and political institutions (Wolfe, 2010).

Table 2.1: Comparison of neoclassical and evolutionary economic theories (adapted from Reinert and Riiser (1994)).

Neoclassical Theory	**Evolutionary Theory**
Use of physical metaphors	Use of biological metaphors
Equilibrium as a central concept	Emphasis on factors causing disequilibrium
Static/comparative statistics	Dynamic
High degree of precision	Less precise, open for non-quantifiable factors
Assumes perfect information	System operates under uncertainty
Time not an issue	Time as important factor 'History matters'
Entrepreneurship unimportant	Entrepreneurship central factor
All economic activities are equal	Economic activities are different because innovation 'focuses' at any point in time
Postulates 'The representative firm'	'The representative firm' does not exist
The market as price setter	The market also as selection mechanism among firms
Technology as a free good	Technology as an important factor in wealth creation and distribution
'The market is always right'/Laissez-faire	Opens for a more active economic policy

As some scholars would argue, the evolutionary approach[1] is a revival and expansion of a classical tradition of institutional economics, often called the 'old' institutional economics (Rutherford, 1996; Hamilton, 1991). This classical institutional approach was initially largely developed by the Americans Thorstein Veblen, John R. Commons and Wesley Mitchell. In particular, Veblen's work is built around a fundamental dichotomy between business and the industrial aspects of the economy (Veblen, 1904). He focused on understanding the role of technological change and its effects on institutional structures, and the ways in which established social conventions and interests resist such change (Silva et al., 2004). Complementarily, Commons (1931) and his followers concentrated on issues related with property rights and institutional connections and their impact on legal and economic power, economic transactions and the distribution of income (Rutherford, 1996).

The 'new' institutionalism is defined to include, among others, the neo-Schumpeterian tradition of thought. The Neo-Schumpeterians look into technology, engineering and business organisation from economic and social sciences perspectives and address the characteristics and dynamics of innovation in order to build an understanding of the interrelations and dynamics between technical and organisational change, between these and economic performance and the reciprocal

[1]See for reference the highly detailed genealogy of economic thinkers leading to institutional and evolutionary economics developed by Radzicki (2003, p. 135).

relationships between technology, the economy and the institutional context (Pérez, 2010).

In this chapter the three traditions are presented in order to argue for a multidisciplinary approach which can accommodate an exploratory and empirical study of the uncertainty behind technological development. This multidisciplinary approach relies on concepts and assumptions arising from these traditions which highlight the interconnection between technology design and innovation, and the interdependence between power and technology, markets and institutions.

The following two sections introduce Schumpeter's approach to innovation and several derived lines of thought which attempt to link technological innovation to economic growth. The second section concludes with the presentation of technological revolutions and techno-economic paradigms and how these concepts seek to highlight the importance of the interconnection between technology, institutions, markets and people. Next, the political economy of communications tradition is presented, highlighting its main assumptions and concepts, and new questions brought to this tradition with the emergence of the Internet. This theoretical tradition has significantly contributed to the understanding of the impact of media in social practices and institutional pressures and vice-versa. The issues revolving around scarcity, market dominance and market power in new media are explained. Section 2.4 presents strategic management, with a particular focus on strategic media management. It explores issues of market structure and ownership through strategic alliances and mergers and acquisitions, and how these strategies allow firms to exert relations of power and control. Finally, the last section presents the multidisciplinary approach adopted in this study along with the core concepts and dimensions, as the basis of a qualitative, case-based and prospective thinking mode of analysis.

2.1 Innovation Theory

Although the concept of innovation was emphasised by Adam Smith and by Karl Marx, Schumpeter is generally credited for identifying innovation as the revolutionising force of capitalism. His views link and underline the interconnections between processes of innovation, economic growth and demise of businesses. Schumpeter is also perceived by many academics to be the founder of evolutionary economics, although he was not able to stop considering himself as a neoclassical economist (Freeman and Louçã, 2001, p. 46).

As some scholars have noted, Schumpeter's views on innovation have evolved over his lifetime. While in his early thinking, innovation was largely dependent on the role of the individual, i.e. the entrepreneur, Schumpeter later recognised the role of firms and R&D departments in supporting innovation. Also, at first, Schumpeter aimed to develop a theory that linked a firm's size to its ability to innovate. He thus defended that small companies would be in a better position to innovate due to their flexibility, but years later, he postulated that rather some degree of monopolistic power would give firms an incentive to innovate. In this case then, bigger firms with more resources and market power would be in a better position.

Schumpeter defined innovation to encompass new products, methods, markets, raw materials and organisational structures. The technological change process was thus characterised as encompassing three (interacting) stages – invention, an exogenous process to the system; innovation, endogenous and primarily determined by the entrepreneurial function; and diffusion, endogenous, but at the same time a source of disruption in the system (Schumpeter, 1950).

Schumpeter also suggested that innovation can only be understood as an historical process and must be linked to the changes in organisational and institutional structure. He mostly analysed the relationship between allocative processes, economic behaviours, innovation and economic change with a historical perspective and focused on the role of innovation in economic growth and occurrence of cycles (Schumpeter, 1939). One of his main concepts, labelled 'creative destruction'[2], asserts that unfit firms either adapt to new technologies or they die. It highlights the idea that innovation can fundamentally change institutions' structure from within by "incessantly destroying the old one, incessantly creating a new one" (Freeman and Louçã, 2001).

In addition, in his view, innovations cluster around certain periods and appear in the neighbourhood of other innovations. He referred to this as 'neighbourhoods of equilibrium' in which innovations stimulate further innovations leading to periods of acceleration and eventual deceleration of economic growth. Schumpeter thus identifies "successive industrial revolutions" as major waves of economic development and technological transformation. He linked this concept to Kondratiev cycles or 'long waves'. These long waves with a duration between fifty to sixty

[2]Reinert and Reinert (2006) argue that the idea of 'creative destruction' entered the social sciences by way of Friedrich Nietzsche and economics via Werner Sombart.

years consist of alternating periods between high sectorial growth and periods of relatively slow growth (Kondratiev, 1925). Many scholars linked to the neo-Schumpeterian tradition of thought analyse technical change from the perspective of innovation, both with economic and social sciences lenses, and try to identify regularities and waves of development and the interactions with economic agents of change. The following section delves further into this tradition.

2.2 Techno-economic Change Theory

Technological paradigm, technological trajectory, technology system, technological revolution, and techno-economic paradigm are all qualitative and exploratory concepts that have been developed by scholars to explain the interconnection between innovation, markets, industries, institutions and agents of change, while acknowledging the historical context and the effects of recurrent phenomena.

Dosi (1982) analyses the role played by economic and institutional factors in the selection and development of 'technological paradigms' and the interaction between endogenous economic mechanisms and technological innovation. By looking into the patterns and regularities in the process of technical innovation, Dosi introduces the concept of technological paradigm as "an "outlook", a set of procedures, a definition of the "relevant" problems and of the specific knowledge related to their solution" (Dosi, 1982, p.148). He argues that the process of innovation is not random, but rather programmed and shaped by the technical design properties, the context (e.g. institutional factors) and the market (e.g. price and demand influence technological opportunities). Based on Nelson and Winter's (1977) 'natural trajectories'[3] concept, Dosi then defines the concept of 'technological trajectory' as the spread of innovation — "the pattern of 'normal' problem solving activity (i.e. of progress) on the ground of a technological paradigm" (Dosi, 1982). By conceptualising technological trajectories (in the scope of technological paradigms) as a set of qualitative, exploratory, and uncertain alternative realities, a number of features are highlighted: the general or more circumscribed, as well as more or less powerful, nature of trajectories; complementarities among trajectories and how developments and lack of thereof impacts developments in other technologies; how a technological trajectory retains cumulative features; the ability to switch from

[3] Nelson and Winter (1977) define 'natural trajectories' as "heuristics that apply when a technology is advanced in a certain direction, and payoffs from advancing in that direction that exist under a wide range of demand conditions". This concept mainly highlights directionality in technological development.

a trajectory to an alternative one, especially when one is considering a powerful trajectory; the uncertain nature of technological paths, as it seems unlikely that one could *a priori* compare and assess the superiority of one trajectory over another (Dosi, 1982). Essentially, a trajectory embodies the pace of development and the directionality of a given technology, characterised by its technical design properties, and influenced by an uncertain context.

Nelson and Winter (1982) use a similar concept, the technological regime, that highlights the link between the various aspects of the innovation process and the technological context. They argue that firms choose a trajectory on the basis of their "selection environment" which includes market demand and non-market inter-industry differences. Therefore, technological regimes constrain the nature of the problems that firms have to solve in their innovative activities, shape the incentives and constraints to particular innovative behaviours and influence the behaviours of competitors and the development of the market sector.

In sum, the concepts of technological paradigm, technological trajectory and technological regime developed by Dosi and Nelson and Winter express the notion of a directionality in technical change and translate the idea that, in competitive environments, technology frequently develops and evolves in path dependent ways, as technological solutions are taken along certain trajectories (Figure 2.2). Moreover, the phenomenon of cumulativeness of technical advances can also be observed in trajectories and paradigms. And finally, interactions between technological factors and social and economic factors are also emphasised, in what concerns continuous incentives, constraints and feedback stimuli.

In contrast to the analysis on the development of individual technologies, Freeman and Louçã, inspired by Schumpeter and Kondratiev's theories of cycles and long waves, further develop a macro-level view of innovation and technological diffusion and their impact on economic growth. In the framework of their theory of 'reasoned history'[4], they develop the notion of 'technology system' based on Schumpeter's idea of clustering of innovations. Freeman and Louçã (2001, p. 146) identify the following phases in the life cycle of a technology system:

[4] Freeman and Louçã (2001, p. 123) argue for "an approach to economic history including technological innovations, structural changes, and the co-evolution of economic and social movements within the framework of institutional settings and modes of regulation". They contend that traditional economics neglects critical qualitative changes in five areas — science, technology, economics, politics and culture — which are interdependent in creating progress.

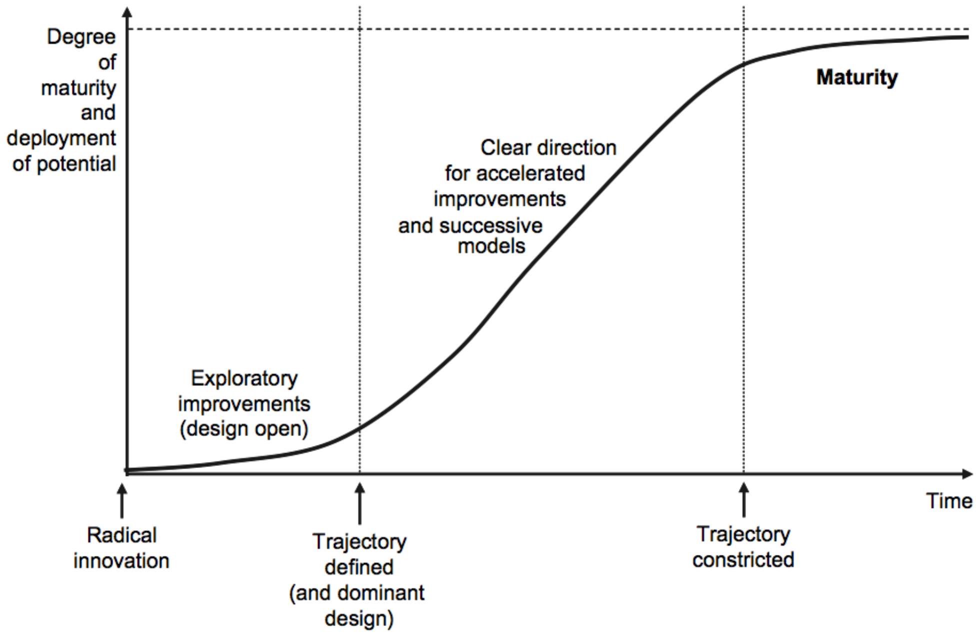


Figure 2.2: The trajectory of an individual technology (Pérez, 2010, p. 187).

1. the laboratory-invention phase, wherein prototypes, patents, demos and early applications are developed;
2. demonstration of technical and commercial feasibility phase, with widespread potential applications;
3. explosive take-off and growth phase during a turbulent process of economic structural crisis and a political crisis of coordination as a new regime of regulation is established;
4. continued high-growth phase, with the system widely accepted and assumed as the dominant technological regime in leading countries; with application in a still wider range of industries and services;
5. slow-down phase, with erosion of profitability as the system matures and is challenged by newer technologies, leading to a new crisis of structural adjustment;
6. maturity phase, with possible co-existence with newer technologies and slow disappearance.

They argue that in phase 1, the economic effects are scarcely perceptible, although this phase might last a long period of time, while in phase 6, the system no longer has the scaling effects on the economy as in phases 2 to 5. Finally, phases 2 to 5 are associated with wavelike movements in the economic and social systems and generate effects not only in the institutional context, but also on the business space, regulation and culture.

The long-wave theory advocated by Freeman and Louçã (2001) is centred on the argument that economic growth needs to be understood in terms of a sequence of eras driven by technologies, although without a tight regularity of timing and duration. Each wave is characterised by the rapid diffusion of a cluster of innovations supported by an appropriate and supportive structure of institutions, which leads to exceptional growth and profits in a new market segment, and eventually, to growth in the broader economy. Although their argument reinforces that technology development drives economic growth, it does not carry technological determinism. The authors have extensively analysed through empirical and historical data the five Kondratiev waves ((1) the British industrial revolution; (2) the age of iron railways, steam power, and mechanisation; (3) the age of steel, heavy engineering, and electrification; (4) the Great Depression and the age of oil, automobiles, motorisation, and mass production; (5) the age of information and communication technology) stressing mostly the changes in managerial and organisational systems that accompanied each technological revolution. For the ICT era, Freeman and Louçã (2001) give an historical account of the institutional and social changes associated with the semiconductor industry, the computer and software industry as well as the telecommunications and Internet sector. Rightly so, they highlight through examples issues of, among others, power (concentration and monopoly), economies of scale, patent disputes, privatisations, deregulation and self-regulation with minimal central control that occurred in these industries and across different countries in the early stage of this era.

Carlota Pérez builds on Schumpeter and Freeman's work incorporating technology historical transformations and makes contributions to the understanding of how these transformations have a wide impact on economic, social and political changes. She stresses the fact that any transformation in technology could only happen through an interactive process of social, political and managerial change. Freeman and Louçã (2001, p. 147) identify Pérez as the first to suggest that ICT is so pervasive that it dominates the behaviour of the whole economy for several decades now and reciprocally is influencing major social and political change.

Pérez advances two interrelated concepts — technological revolution and techno-economic paradigm — in an attempt to identify the regularities, continuities and discontinuities in the process of innovation. The first concept encompasses "a set of interrelated radical breakthroughs, forming a major constellation of interdependent technologies; a cluster of clusters or a system of systems" (Pérez, 2010, p. 189). Pérez places these technological revolutions interconnected with technology systems (as studied by Freeman and Louçã (2001)), which are in their turn interconnected with individual innovations. Technological revolutions have a lifecycle of about fifty years, through phases of explosive growth, fast diffusion of the new industries, technology systems and infrastructures, then full deployment of the paradigm culminating in a maturity and market saturation stage (Figure 2.3). Pérez also highlights the basic features of technological revolutions as being their strong interconnectedness and interdependence of the participating systems in their technologies and markets and their capacity to transform profoundly the rest of the economy and eventually society too. This capacity to transform other industries and sectors across the board stems from the influence of its interconnected techno-economic paradigm.

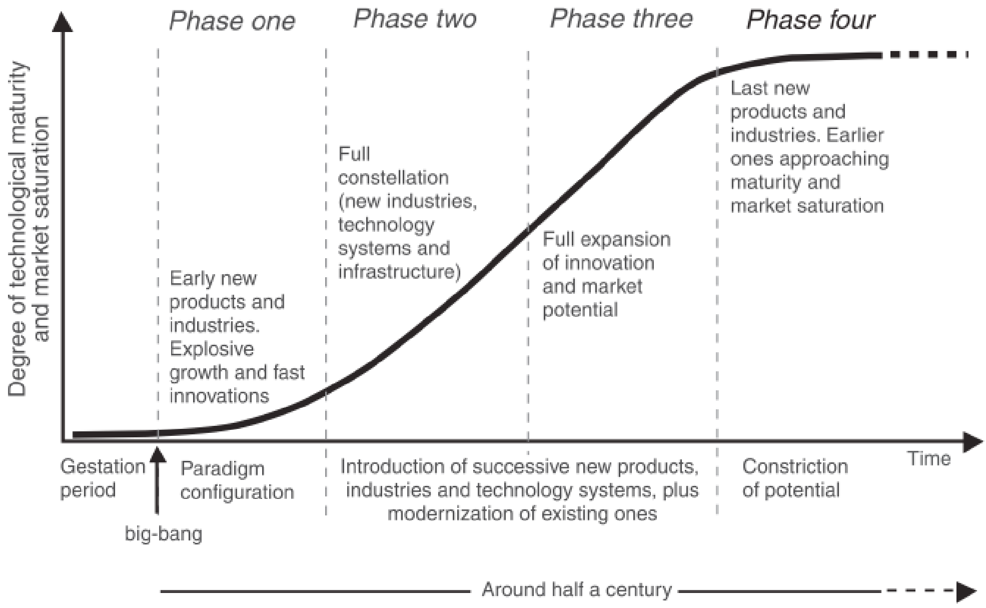


Figure 2.3: The lifecycle of a technological revolution (Pérez, 2002, p. 30).

Pérez argues that it is the techno-economic paradigm that enables and multiplies the impacts of the technological revolution across the economy through a broad reorganisation and widespread rise in productivity as well as a transformation of social and institutional structures. This techno-economic paradigm is defined as the "set of the most successful and profitable practices in terms of choice of inputs, methods and technologies, and in terms of organisational structures, business models and strategies" (Pérez, 2010, p. 194) and indicates the "optimal, most effective and most profitable way of making use of the new innovative potential" (Pérez, 2010, p. 200), shaping institutional and social aspects, expectations and behaviours.

Based on the processes of diffusion of each technological revolution and its techno-economic paradigm, Pérez presents the great surges of development model. She argues that the concept of great surges differs[5] from the notion of long waves. The latter concept focuses on the ups and downs of economic growth driven by technology, while the former aims at pointing out the effects of technological revolution diffusion on economic and social aspects, including among them economic growth. Hence, the upswings and downswings of economic growth are explained not only by technical change, but also by the diffusion of successive technological revolutions and by the interactions between technology and institutions in a changing historical context, enabling the creation of new industries, services and jobs accompanied by the destruction of the old ones.

All these concepts related to technological innovation show multiple attempts to deal with technology design and the diverse and uncertain impact it has on innovation. Each wave, each trajectory, are exploratory and could have different configurations depending on the initial technical design and the interactions between technology, markets and institutions. Although theories of innovation and technological change attempt to address the interdependence between technology, markets and institutions, while acknowledging the existence of power issues in this interrelationship, they lack the political and critical approaches to analyse the unbalanced relations resulting from the production, distribution and consumption of technology. Political economy of media and communications tradition provides the complement to these theories and allows to derive insights about articulations of control and power, and why and how certain technologies and firms achieve dominance.

2.3 Political Economy of Communications and New Media

Political economy has many traditions and schools. Mosco (2009, p. 2) defines political economy of communication as "the study of the social relations, particularly the power relations, that mutually constitute the production, distribution, and consumption of resources, including communication resources". However, Winseck (2011) argues this is a rather narrow view of the political economy

[5] This difference has repercussions on the dating and duration of each surge compared to each long-wave.

of the media. Thus he outlines four main perspectives in political economy of communication, namely:

- conservative and liberal neoclassical economics;
- radical media political economy, with two main versions, the monopoly capital and digital capitalism schools;
- Schumpeterian institutional political economy, including the creative industries and network political economy schools;
- cultural industries school.

Such classification combines and borrows ideas and fundamental concepts from neoclassical and evolutionary economic theories, as well as communication studies in relation to creative and cultural studies. Nevertheless, "all approaches to the political economy of media take it as axiomatic that the media industries -— the structure of the markets they operate in, their patterns of ownership, the strategies of key players, trajectory of development, and so on —- are important objects of analysis" (Winseck, 2011, p. 11).

The neoclassical approach is mainly divided in two strands based on how each recognises the potential for market failure and governments' role. Winseck (2011, p. 17) notes that in the neoclassical approach "any notion that information is scarce is a delusion".

Within radical political economy, Winseck (2011) cites the work of Robert McChesney as associated with the monopoly capital school, and Dan Schiller and Vincent Mosco with digital capitalism. He contends that neither of these approaches devotes enough attention to explaining the complexity of the media industries and the pervasive role of uncertainty across all levels of the media. Winseck (2011, p. 23) criticises the first approach for encompassing a static view of the world and depicting media industries as "a giant pyramid, with power concentrated at the top and not enough attention paid to the details of key players, markets, and the dynamics and diversity that exist among all the elements that makeup the media". On the other hand, the continuity of capitalist dynamics implicit in the digital capitalism school overplays the role of market forces in media businesses and regards commodification as a pervasive process of all cultural forms.

Furthermore, Winseck (2011, p. 25) highlights the main differences between the Schumpeterian institutional political economy and the two previous perspectives as lying on how technological innovation is the main motor of competition in capitalist economies, how this competition "creates temporary monopolies and superprofits, but these are likely to be short lived because 'superprofits' attract new rivals", on creative destruction being the central process in capitalism, and on how technology and economics are viewed as "'agents' of change over people and social force".

Regarding the last political economy perspective, the cultural industries school, Winseck (2011, p. 29) underlines the engagement with the Schumpeterian institutional political economy and the prominent work of Nicholas Garnham. He argues that this perspective puts a great emphasis on the unique and specific attributes of the media economy and the persistent barriers that impede the wholesale commodification of culture.

Drawing from these four perspectives and potentially at the risk of being too technology deterministic, this thesis is closely positioned in the Schumpeterian institutional political economy. As it has been argued, digital media, telecommunications and the Internet have transformed media processes and structures in the 90s and early 2000s. This also suggests that as the Internet is changing over time and space, its potential impact on digital media will also differ over time (Winseck, 2011, p. 41). Scholars such as William Melody and Robin Mansell acknowledge that technological innovation and society can mutually affect each other:

> The key issues for inquiries into the social and economic implications of advanced information and communication technologies concern the dialectical processes of changes in socio-economic and technical systems, the dynamics of their reproduction, and how and by whom such systems are controlled.
>
> (Mansell, 1996, p. 40)

Some scholars have thus dedicated effort to explore how ICT developments are influenced by multiple designs and by control and power relationships. For instance, Mansell's (1993) seminal work on the dynamics of change in the electronics communication environment linked the political economy of communications with an in-depth analysis of technology design. Through a number of case studies, Mansell explored the political, economic and technical factors contributing to the future of telecommunication networks and the creation of intelligent networks. She sketched out two different scenarios, an 'Idealist Model' and a 'Strategic Model', to investigate the process of network evolution under the influence of different policy decisions and technical design choices.

Recent calls for a revitalisation of research on new media, i.e. on recent developments in digital ICTs and related innovative ideas and technologies (Mansell, 2011), in the tradition of political economy advocate for a more holistic account of the dynamics and power articulations of new media production and consumption as well as for new research and insights relating structural and processual power (Mansell, 2004, p. 75). Mansell (2004) suggests an interdisciplinary research agenda for the study of new media, acknowledging the convergence between media, communications and ICT. This agenda intends to bring together political economy and considerations from economic studies on innovation and institutional economics.

2.3.1 From Scarcity to Market Dominance

The political economy of communication traditionally focused on questions related to commoditisation and processes of scarcity created in content production and media consumption of traditional media (Garnham, 1979; Smythe, 1960).

With telecommunications diffusion and Internet massification, other issues and articulations of power have been brought into the discussion, namely monopolisation and market dominance. Specifically for the case of online video services, these services strongly rely on branded content produced, aggregated and distributed by long-established firms in the media industry. These firms are accustomed to a model where 'scarcity' prevails, with high access barriers, high costs and highly controlled production and distribution streams (Shoemaker, 1996; Baye and Morgan, 2001; Hutchins and Rowe, 2009). The Internet and the online model present significantly lower access barriers and costs for all players, even for the established ones in the media industry, allowing a growing number of players to appropriate, modify, and share digital content. However, as many scholars argue, the media industry incumbents fear losing their market power and make use of copyrights management and development of technical standards to reinvent scarcity and bottlenecks (Mansell, 2004; Küng et al., 2008; Evens, 2010). For instance, Nelson (2013) depicts how the video industry maximises revenue and profits via windowing. Content providers usually ensure exclusivity and property rights depending on the transmission platform (e.g. retransmission rights), on the temporal distance, windowing, from theatrical show (e.g. movies), with hardware/software copy control mechanisms (e.g. DRM mechanisms) and/or with territorial broadcast restrictions (e.g. sports).

In a political economy of new media, the emphasis turns to the circumstances that originate certain structures and distributions of power and the consequences for consumers and citizens (Mansell, 2004). Although technological innovation has undeniably created abundance of new digital products and services, at the same time, monopolisation strategies create the appearance of scarcity in new media in the forms of limiting access, promotion of obsolescence, and copyright of content and resources (Mansell, 1993, 1999; Pereira, 2009). These monopolisation strategies refer to "the activities of firms (usually dominant ones) who are seeking to build up, or maintain, a position of market power" (Clark, 1961) (cited in (Mansell, 1999)). Firms make use of several strategies in order to monopolise existing and new markets through ownership or control of infrastructure and/or content, or by trying to enter new sectors increasing the scale of their operations through diversified strategies of acquisitions and alliances with other stakeholders (Mansell, 2012). These strategies are crucial factors in establishing competitive advantage and market dominance, while also enabling stakeholders to acquire market and customer information, which may become important sources of market power. Moreover, they contribute to raise entry barriers for new players in the market, raise prices and restrict (innovation) output (Doyle, 2013). For instance, patents and IPR are no longer being used to deter competitors from developing similar technologies, but increasingly to delay the deployment of competitors' technologies and prevent competitors to achieve an established position in the market (Melody, 2013). The term 'patent troll' started being used to identify entities that not make or sell anything. They just inhibit innovation and economic growth by adopting a behaviour of looking for violations and then pursuing litigation and licensing agreements. In short, the accumulation of a dominant market position might create opportunities for dominant firms to raise prices and engage in business practices which are intended to squeeze rivals out of the market, control the development of the market, lock-in customers, and raise barriers for new players to launch new products and services, jeopardising public interest. In the digital economy, the means to achieve market dominance might have slightly changed, but the end goals are still the same. As Wasko et al. (2011) acknowledge, the digital media environment (and Internet) are "a new field of struggle dominated by long-standing battles and combatants".

2.3.2 Power and Control Issues

In a political economy of new media it is also relevant to understand how structures of power are formed and evolve over time and to understand which may be the consequences for consumers and citizens (Mosco, 2009; Mansell, 2004), for example in terms of service diversity, alternative forms of supply, etc.. Power can take many forms but is usually manifested through control and may be influenced by the conditions in the marketplace, regulation and competition policy. In this thesis, power is analysed under the conceptualisation of market power[6] with a focus on practices and strategies which lead to power asymmetries among market players with potential impacts on market dynamics, technology development and service diversity. The notion of 'control point' presented by Trossen and Fine (2005) reveals a means to describe the generation of value as well as a socio-technical mechanism enabling the 'controller' to exert power over other actors in an ecosystem. In this scope, market power is derived from the ownership of control points, which are often also critical resources with limited supply and high demand, i.e. reveal signs of scarcity.

In the digital age, power positions in the ecosystem strongly often depend on who controls key 'control points' of the communications infrastructure or services. For instance, telecom operators have always controlled the key points in communications infrastructure, i.e. adopting the role of access 'gatekeepers' as well as controlling the development of the market. But also in the new ICT ecosystem, monopolisation strategies aimed at controlling access to networks and/or electronic information products and services exist (Eaton et al., 2010a). In a converged ecosystem, bottlenecks can occur on content production and distribution stages and also on any of the platforms and interfaces facilitated by digital technology (Doyle, 2013). For instance, set-top boxes and digital media players are examples of control points of access to the networks and online products and services (Nicita and Rossi, 2008). While they are required to access content, they are also locking-in customers in the service or platform with guaranteed revenues to cover for investments in content. Furthermore, other commercial strategies, quite popular in the Internet, which consist in bundling services or establishing pay walls, also give scope to the establishment of power relations

[6] A simple definition of market power entails market share and is manifested through a firm controlling a large portion of the market. Market concentration is one indicator of the ability of firms to exercise market power and used to show the extent of market control. There are standard tools to measure market concentration, such as the Herfindahl–Hirschman Index (HHI). This index measures the size of firms in relation to the industry and gives an indication of the level of competition between them. However, it does not reveal how market power is exerted, nor the practices that influence market dynamics, technology development and consumer options.

with consumers. In this regard, Mansell (1997) questions the ability of key players to continue to exercise market power on the dialectics of economic incentives versus technological change. Will economic incentives encourage the maintenance of market power or will rapid technological change prevent markets from being dominated by a small number of large firms? In addition, does market power favour incumbents or new entrants interests? She argues for regulation and competition policy as important tools to ensure that competition in the market prevails as well as to keep the market open to new players.

However, previous forms of public intervention in the communications industry are unlikely to be successful as this market was highly segmented in different sectors, e.g. cable, satellite, mobile, etc.. With the convergence on the supply side between media and communications industries, effective regulation seems increasingly difficult as firms' strategies involve more and more partnerships, alliances, mergers and acquisitions with suppliers and competitors in intertwined sectors. Thus, understanding and positioning these strategies becomes important to this study and to analyse power and control in the current standing and future development of online video services. The next section provides an overview of the field of strategic management and discusses the concepts of alliances and mergers and acquisitions towards a joint typology.

2.4 Strategic Management

Strategic management is a field of study, under which many different theories have emerged since the late 1960s rooted in a variety of prior theories such as industrial organisation economics, game theory, leadership, evolutionary theory and cognitive models (Chan-Olmsted, 2005, 2006b). According to Albarran (2006), "strategic management is concerned with developing the tools and techniques to analyze industries and competitors and developing strategies to gain competitive advantage". Chan-Olmsted (2006b) divides the field in two approaches: the prescriptive and the evolutionary. The first approach depicts strategy as a rational and linear process with well-defined and developed elements before the process begins, while the second approach is less concerned with the process at its start, and views the process as evolving and adapting over time. Küng (2008) based on Chaffee (1985) draws similar boundaries between the different approaches but provides a categorisation of strategic theory into three core schools. First, the rationalist strategy, focuses on planning and forecasting the strategic behaviour of firms, the structures of markets and their interactions, and hence, puts great effort on the content of the strategic plan. Similarly to the prescriptive approach, the rationalist approach also assumes a linear process to be applied as if the environment conditions do not change. It relies on a first comprehensive analysis of the environment, deriving environmental opportunities and threats, which contribute to understand and diminish uncertainty and complexity of the strategic environment towards optimal performance. The strongest theoretical influence of this school is the work of Michael Porter, its Five-Forces Model and Value Chain Model. Secondly, the adaptive school, contrary to the rationalist, puts more emphasis on the process than on the content of the strategy. Identically to the evolutionary school, this approach regards strategy as an iterative and gradual process of adaptation and self-renewal wherein firms undertake a series of strategic readjustments in response to a changing and uncertain environment, particularly technological change and waves of 'creative destruction'. Strategy is not static, but rather emerges as it is being implemented. The tools in this approach seek to support firms in the design and redesign of the structures and processes in order to enable a dynamic strategic positioning in the changing environment and models that provide insight about which technology will dominate after a technological transition. Thirdly, the interpretative approach, is much less developed and often characterised to be vague and subjective, as it focuses on factors that are frequently disregarded, difficult to access and interpret, such as mindset, belief systems, values, motivations and emotions, but which are considered to both help and constrain strategic planning.

Most of the concepts and academic work in strategic management are to be situated in the rationalist and adaptive/evolutionary approaches. In the context of this study, the focus is on strategic responses of media and telecoms firms to technological change and a changing business environment. The spread of digital technology in the past decades has affected corporate strategy and contributed to the spread of cross-sectoral ownership (especially between IT, telecommunications and media companies) with several goals, among which, reduce competition, gain access to resources or restricted markets, quick market entry, achieve vertical integration, maintain market dominance, establish industry standards, exploit economies of scale and scope, increase negotiation leverage, and prevent overcapacity in the market (Chan-Olmsted, 2004; Doyle, 2013), can be highlighted. In close connection with political economy, one can argue that these responses allow firms to exert relations of control and power towards dominant market positions. From a rationalist strategy perspective, technological change can be analysed as the driver to lower entry barriers, to alter value chains or to exploit economies of scale and scope. Through the adaptive perspective, as the complexity of a changing environment/market is considered, the analysis turns to the ways firms alter structures, change processes and systems to e.g. gain access to resources or establish standards. The next subsections address firm-level responses to technological innovation, mostly from an adaptive perspective and specifically related to market structure and ownership.

2.4.1 Strategic Alliances and Mergers and Acquisitions

Alliances are a tool widely used for strategic growth in the media industry (Chan-Olmsted, 2005) and, over the past decade, the increasing number of mergers and acquisitions between media, telecommunications and IT's territories has contributed to blur the boundaries between these sectors. This section, first, addresses strategic alliances, and then, mergers and acquisitions as strategic tools, concluding with a taxonomy that summarises both approaches.

Strategic alliances comprise cooperative arrangements between two or more potentially competitive firms, but the term can also encompass strategic joint ventures, short-term partnerships, cross-border and inter-sector alliances. Strategic alliances may be governed through many forms, from specific functional agreements – licensing, R&D consortia, strategic cooperative agreements – to joint ventures, and to the ultimate form of mergers and acquisitions (M&A) (Sheth and Parvatiyar, 1992; Chan-Olmsted, 1998; Ariño et al., 2001; Todeva and Knoke, 2005; Küng, 2008). In essence, firms seek out such partnerships to gain access to information, competencies, markets, and technologies, speed up entry or reduce barriers in new markets, and to reduce the risks of new products or services (Chan-Olmsted, 2005; Küng, 2008).

In an attempt to develop a general theory of business alliances, Sheth and Parvatiyar (1992) developed a typology based on two constructs: (1) the purpose of the business alliance (strategic versus operations) and (2) the parties involved in the business alliance (competitors versus non-competitors). In their view, a business alliance is "an ongoing, formal, business relationship between two or more independent organizations to achieve commons goals" (Sheth and Parvatiyar, 1992, p. 72). The dichotomy strategic versus operations intends to capture the degree of uncertainty by focusing on the corporate purpose alliances intend to fulfil. Strategic alliances purposes (e.g. growth opportunity, diversification, strategic intent and protection against external threat) affect firms' future position and competitiveness, while operational alliances purposes (e.g. asset utilisation, resource efficiency, enhancing core competences and bridging the performance gap) are intended to impact corporate efficiency and improve the current position of a firm. Along with the alliance purpose, the parties in an alliance and their role form the other dichotomy in this typology. Customers, suppliers as well as potential customers and suppliers are considered non-competitors. Existing competitors, new entrants, substitute producers (indirect competitors) and potential competitors are competitors. Given these two dimensions, Sheth and Parvatiyar's typology consists of four types of business alliances (Table 2.2)): (a) cartel, a business alliance formed for operations efficiency among competitors; (b) co-operative, a business alliance for operations efficiency among non-competitors; (c) competitive alliance, a business alliance for a strategic purpose among competitors; finally, (d) collaborative venture, with a strategic purpose among non-competitors. As the authors mention, many authors have started to use the term "strategic alliance" as a common term to refer to all types of business alliances, independently of their purpose. In this study, Sheth and Parvatiyar's typology will be adopted for further analysing alliances, with particular focus on strategic alliances between competitors and non-competitors.

Table 2.2: Sheth and Parvatiyar's typology of business alliances.

		Parties	
		Competitors	**Non-competitors**
Purpose	**Strategic**	Competitive alliances	Collaborative ventures
	Operations	Cartels	Co-operatives

Mergers and acquisitions deals can usually be related to strategies to achieve corporate growth, create or reinforce market power, and generate economic efficiency gains through economies of scale and scope. In this period of technological change and deregulation, M&A became a popular tool to promote media giants, e.g. Comcast, News Corporation, Bertelsmann. To quickly establish a presence and leadership in an existing market are important incentives for many firms pursuing M&A activities (Chan-Olmsted, 1998). But M&A are also often seen as the best opportunity for firms to grow and implement new technologies with combined resources in a short time, while capturing an already developed customer base (Chan-Olmsted, 1998). In addition, media and telecommunications firms have been considering cross-industry mergers as an opportunity to obtain resources for new technologies and new markets. Finally, as a result of increasingly blurry boundaries between media, telecommunications and IT sectors and the growth of global multimedia conglomerates, M&A allows firms to compete multilaterally in several media markets and multiple countries concurrently (Chan-Olmsted, 2004).

Peltier (2004) focuses on the analysis of M&A deals in the context of media industries and highlights a number of goals specifically related to the sector and to issues of power and control: (a) control access to a scarce resource, i.e. content; (b) ensure access to distribution networks for content; (c) research of size effects, i.e. economies of scale and scope; and (d) increase the international distribution of products. Peltier's (2004) typology is summarised into five M&A types, which can have simultaneously operations and strategic purposes: horizontal concentration, upstream vertical integration, downstream vertical integration, diversification and conglomerate. As noted, in practice, in one deal, one or more strategies can be applied. Horizontal concentration occurs in deals with firms in the same industry, which produce identical or similar products, allowing the new firm the possibility to achieve economies of scale in an enlarged market share, realise economies of scope through the shared use of specialised resources or expertise across several products, and increase market power vis-à-vis its suppliers and buyers. Upstream vertical integration involves a downstream firm (e.g. a content distributor) acquiring an upstream firm (e.g. a content producer), in order to guarantee access to content. On the contrary, in downstream vertical integration, a content producer may wish to ensure an outlet for its content buy acquiring a downstream firm. Vertical mergers usually result in maximised revenues and reduced transaction costs. They are mainly motivated by market foreclosure, in order to secure resources, and weaken competitors by reducing their supply of content/inputs or their options to sell, allowing firms to have some control over their operating environment and potentially avoid the market power of dominant suppliers and buyers. Diversification occurs when a certain firm enters a different business, but somehow related to its own businesses. Finally, a conglomerate strategy is characterised by a firm entering a business unrelated to its own businesses.

Combining Sheth and Parvatiyar's definition of strategic alliance with Peltier's five types of M&A, one can structure the latter types into the two groups of parties (competitors and non-competitors) involved in a strategic alliance. In the empirical part of this study strategic alliances and M&A are considered to have a similar business dynamics and will thus be considered in their competitive and collaborative different forms as summarised in Table 2.3.

Table 2.3: Forms of business alliances, resulting from combining Sheth and Parvatiyar (1992) and Peltier (2004) works.

Parties	Types of strategic alliances	Forms of strategic alliances	
Competitors	Competitive alliances	Functional agreements	
		Joint ventures	
		M&A	Horizontal concentration
Non-competitors	Collaborative ventures	Functional agreements	
		Joint ventures	
		M&A	Upstream vertical integration
			Downstream vertical integration
			Diversification
			Conglomerate

2.5 Towards a Multidisciplinary Approach

This section presents the motivations for a multidisciplinary framework to address the introduction of Future Internet or, depending on the perspective, the evolution of the current established Internet, in the converging markets of media and telecommunications. The rationale behind this proposed approach is grounded on the importance of considering the interrelationships between technology, institutions, markets and policies and the issues that emerge from those relationships that potentially contribute to shaping technology introduction and diffusion. As illustrated in Figure 2.4, technology has an influence on institutions' organisation and positioning as well as on disrupting the market. Institutions have an impact on the structure and performance of the markets, while markets and technologies often trigger the need for a realignment of policies and have an impact on economic growth. Policies have an impact on, constrain or promote, the development of technology and often stimulate market competition.

Therefore, this approach relies on concepts and assumptions arising from innovation theory, political economy and strategic management literature. Table 2.4 highlights the main issues/concepts with relevance to this study. In general terms, all three perspectives previously introduced highlight the need to explore the dynamics of innovation and technology design embedded in technological change. They also argue for studying (empirically) the articulations of power and control in the interdependence between technology, markets and institutions. Finally, research drawing on these traditions are of exploratory nature, prospective and comparative, putting in perspective a number of potential developments characterised by different technology design configurations.

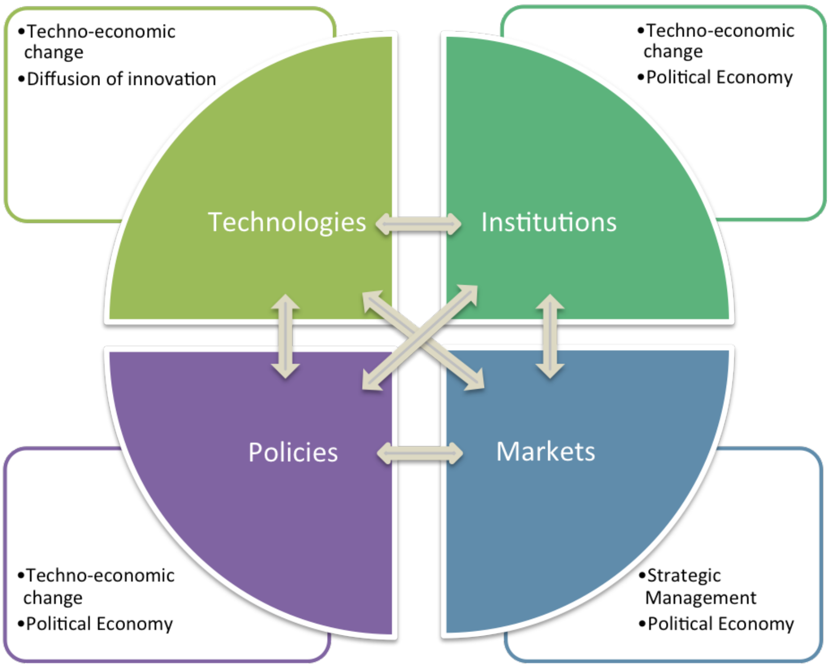


Figure 2.4: Towards a multidisciplinary approach

Table 2.4: Relevant concepts and issues.

Innovation	Political Economy	Strategic Management
• Technological design/ change • Resources/capabilities • Political systems	• Power and control • Scarcity • Political systems • Policy and regulation	• Competitive strategy • Technological change • Market power • Resources/capabilities

By combining these three traditions the goal is not to oversimplify the relationship between technology and institutions and their organisational behaviour nor to overemphasise the impact of technology and innovation on strategic outcomes. But, rather to go beyond the perfect competition and assumptions and challenge the status quo of economic efficiency accepted by neoclassical economics. Thus, it can be argued that in order to tackle these issues, a prospective, exploratory and multidisciplinary approach is needed in order to analyse the interplay between technology design, policy, institutions and markets, and to evaluate various configurations of future evolutions. The combination of the three traditions will allow to put emphasis on the following tasks: (1) an exploratory analysis of the current circumstances and an historical perspective of the broader context of the mature industries of media and telecommunications; (2) derive qualitative insights about the articulations of power and control and how these influence competition and strategic behaviours; (3) reveal policy and strategic dynamics behind technological design and market restructuring; and (4) work under scenarios, which critically examine how technology change and innovation can bias economic, social and market conditions.

This multidisciplinary approach will facilitate the study of the underlying technical and policy factors influencing new digital media services market trends and the identification of technical, regulatory, business and social factors that will potentially shape how the market, institutions and policies will evolve subject to technical change.

The following chapter proposes a methodological framework designed to study power and control issues and explore the dynamics of technological innovation through multiple scenarios.

Chapter 3

Research Design

This research aims to analyse the current circumstances of online video services, providing an historical perspective of the broader context of the mature industries of media and telecommunications, and also convey a forward-looking perspective of what the future might hold for online video services, once Future Internet and Future Media Internet technologies are deployed.

The widespread of different online video services and supporting technologies shows that innovation is on a fast pace, mostly incremental innovation (Henderson and Clark, 1990), as new technical functionalities have been deployed and new models of engagement embracing Internet connectivity are being experimented. As a critical mass willing to pay for these services is developing, this is having disruptive repercussions on service demand and competition amongst players. Some players are showing to be in a better position to compete and build their customer base, presumably because they control critical resources for service provision. The notion that power positions in the ecosystem strongly depend on who controls key 'control points' of the infrastructure or service has been argued for in the previous chapter.

However, as these services require high bandwidth and low delay transmission, and drive high amounts of traffic, they are putting pressure on the Internet architecture to evolve. Future Internet architectures may hold the response to current and new consumer and technological requirements and, in specific, to video-based services. However, structural changes to the architecture of the Internet may result in the formation of new bottlenecks and new ways to control critical resources. In this regard, the relationship between architectures and innovation was first proposed by Henderson and Clark (1989) through the notion of architectural innovation, which "is the reconfiguration of an established system to link together existing components in a new way". Baldwin and Clark (2000, 2006) also argue that architectural innovation allows system designers to experiment with different ways and conditions to build up a system, and measure how performance changes in each design. As performance is constrained by a bottleneck involving one or more system components, knowledge of bottlenecks is thus crucial to achieve architectural innovation. They convey that by studying the underlying cause and effect relationships in a complex architecture, one can identify the bottlenecks and (re-)design architectures encompassing modularity[1] in the interfaces of key components and thus attain higher levels of system performance. With knowledge of bottlenecks and potential new modules, firms understand better their industry structure, can improve their innovation processes without sacrificing either performance or cost, and offer competitive products and services. Around the same notion of architectural innovation, Van Schewick (2010) shows how the design principles of the current Internet impacted and fostered innovation and the design of products and services. She argues that economic actors exploit the economic effect of architectures by engaging in strategic design, i.e. in shaping architectures in their economic interests. Through an architectural strategy, firms are able to control competition between complementary services, as well as openness and standardisation of architectures and services.

As these authors point out, the identification of bottlenecks and control points in a service architecture is in large part responsible for innovation and contributes to the accumulation of knowledge and competencies. However, they do not really operationalise how to research the underlying cause and effect of bottlenecks on sector strategies and dynamics. In line with the concept of architectural innovation, Trossen and Fine (2005) acknowledge the need for methodologies and tools to evaluate the impact of control points on innovation and the alignment of value chains. Within the context of communication network architectures, they recognise that topological constructs such as core and edge no longer suffice to lay out the possible future industry value chain. They argue for new methodologies that not only rely on the impact of topological constructs, but also incorporate the functional components and their high level implementations. Hence, they propose a set of tools to study the dynamics of the value chain, ranging from business model level questions to the dynamics of the entire value chain, and to predict possible dynamics, targeting to devise longer-term strategies for the overall positioning of firms in the value chain.

[1] By modularity, Baldwin and Clark (2000) mean building complex products from smaller subsystems that can be designed independently yet function together in a variety of ways, following a variety of architectures.

The methodology presented by Trossen and Fine (2005) and developed within the Value Chain Dynamics Working Group (VCDWG), part of the MIT Communications Futures Program (CFP), suits this study in what concerns deriving insights about the articulations of power and control and how control points influence stakeholders' positioning and strategic behaviour. Through expert interviews, these control points will permit to uncover how actors exercise control within value networks and to characterise value generation. In addition, in order to reveal policy and strategic dynamics, the conceptualisation of triggers influenced by control points will help uncovering future changes to the business models. Given the uncertain nature of identifying potential scenarios, the methodology will be enriched with an iterative process of interviewing relevant stakeholders, contributing to and enriching both the knowledge on control points and providing feedback to the analysis and the triggers influencing the future of the current Internet and of online video services.

The following section presents the methodology developed by the Value Chain Dynamics Working Group and the adaptations that will be made to it in the context of this research. Sections 3.2, 3.3 and 3.4 unfold the qualitative nature of this study, based primarily on desk research, document analysis and expert interviews. The remaining sections explain the value of enriching the methodology with value network analysis, business modelling analysis and scenario building, and how these tools will be operationalised.

3.1 Methodological Approach

The approach chosen in this study takes as basis a methodology developed by the Value Chain Dynamics Working Group (Trossen and Fine, 2005), part of the MIT Communications Futures Program, a research collaboration between the MIT and industry, and further adapted by Eaton et al. (2010b) as part of a research programme of the Mobile Virtual Centre of Excellence (MVCE), a UK industry academic research consortium. Although VCDWG's workplan aimed at developing a methodology to enable the detection of positions of economic power for different services within the telecommunications industry, the methodology distances itself from telecom topological constructs such as core, access or edge within a communications network, as these are increasingly decoupled from business propositions and less relevant to establish the business success of the communications industry. This fact actually determines that the methodology can also be used to study other business industries and not only the telecommunications industry. The VCDWG has applied this methodology in case studies related with IPTV, online music stores and RFID.

VCDWG's methodology is centered on analysing the control points within an industry and then on understanding the business sustainability of different business model scenarios over time through the notion of triggers, i.e. external factors. A control point is defined as "a functional element at which management can be applied", although the "degree and scope of control that can be leveraged from a given control point will vary" (Trossen and Fine, 2005; Klym, 2005). Control is exercised on a control point through business, regulatory, and/or technical means (Klym, 2005; Klym and Trossen, 2006). Essentially control points enable an actor to exercise power over other actors in the value network. In the methodology, these control points facilitate the construction of potential business models, which in turn can be evaluated in terms of viability and sustainability. And then triggers are considered as any external factor that can cause a transition from one "constellation" of control points to another, i.e. to another business model (Klym, 2005). These external triggers, originated in regulatory, technical, social and business factors, can induce an increase or decrease in the strength and importance of control points, consequently affecting the sustainability of business models.

VCDWG's methodology comprises four high-level steps as summarised in Figure 3.1. Firstly, the value chain within a particular industry for a given type of service is identified and then a taxonomy of control points is built through interviews with relevant experts across the value chain. The various players in the value chain are identified and the control points in delivery, service and management infrastructure at which these players exert control are enumerated. Secondly, constellations of control points within each service offering are constructed. These constellations effectively illustrate different potential business models representing diverse alternatives in which control can be exercised. Thirdly, the identification of trigger points causing change takes place. As already mentioned, these triggers emerge from regulation, technology, social and business factors, which may have an impact on the dynamics of business models at the micro level and may cause changes in the industry value chain at the macro level. Triggers may also indirectly shape the dynamics of business models by affecting a chain of other triggers which may in turn directly have an effect on a control point. Hence, trigger dynamics may be further refined using Fine's Gear teeth model (Fine, 1998) and categorised in technology, business cycle, industry structure, regulatory policy, customer preference, capital market and corporate strategy dynamics. The essence of this methodology is in fact on understanding how triggers may influence the change of control points over time. Hence, the final step consists of capturing the cause and effect of triggers and build potential scenarios that may capture the essence of control points and how these may change over time. Besides time, three other key properties are used to ascertain changes in control points: scarcity or interchangeability, demand and value. Interchangeability captures the number of actors in the market compared to the size of the market, leading to monopolisation or commodification conditions. Demand expresses the potential market share that can be captured by a control point or a service offering, e.g. number of subscribers, sales revenue. Value can be seen as a function of scarcity and demand, to denote where and how a certain control point can capture value.

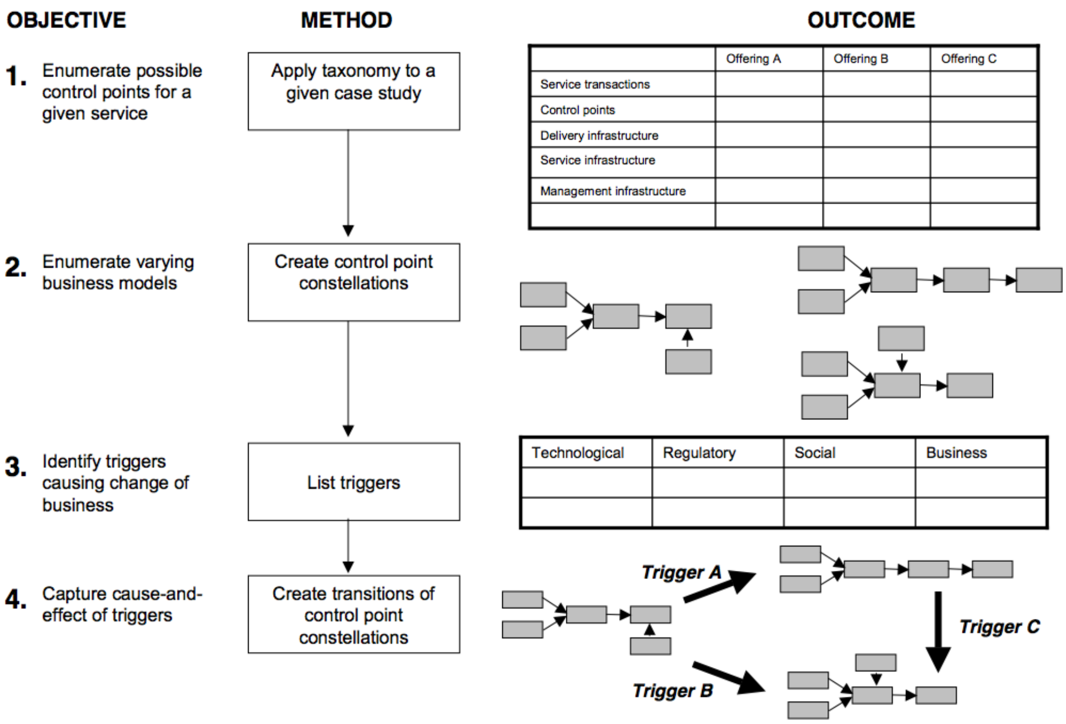


Figure 3.1: VCDWG's methodology for identifying business models scenarios for the telecommunications industry (Klym, 2005).

Although VCDWG's methodology provides a straightforward step-by-step approach to capture control points and predict potential evolutions of business models subject to changes in regulation, technology, society and business, several shortcomings can be identified. First, as Eaton et al. (2010b) also pointed out, is not ideal to focus on value chains given the networked organisation topology of today's industries. In the past decade, both the media and telecommunications sectors shifted from a monolithic vertically integrated structure controlling all stages of a traditionally organised value chain to a fluid network structure of companies working together through a wide range of partnerships and alliances (Küng, 2008; Li and Whalley, 2002). Second, in VCDWG's methodology, once control points are identified they are evaluated as centralised versus distributed aspects in the value chain, which seems a rather narrow scope. Third, the business models constructed to illustrate control point constellations are focused on one service offering of a particular stakeholder, rather than generalised across the sector or industry. Finally, the VCDWG methodology does not present straightforward guidelines on how to group control points in constellations, except for arranging control points in a logical sequence, depending on how tightly or loosely coupled the components are and on how integrated are certain control points (Klym, 2005; Klym and Trossen, 2006).

In order to address these shortcomings, the following changes to the implementation of the VCDWG's methodology are proposed:

1. focus on value networks instead of value chains;
2. evaluate control points beyond centralised vs. distributed aspects of control points;
3. examine business models across a sector and for specific types of services, and, if relevant, consider to put particular emphasis on groups of actors;
4. group control points around gatekeeper roles, instead of control points constellations.

To address these limitations, the business model ontology developed by Ballon (2007) brings in dimensions of control related to value and the functional architecture, which in this case, is valuable to reflect on actors' control stances. In this regard, Ballon developed the business model configuration matrix (BMCM) (Figure 3.3) which will be discussed in this chapter. Ballon (2009b) also introduced the concept of gatekeeper role within the context of mobile service delivery business models to analyse which actors exert most control in a value network. Ballon advances that gatekeeper roles not only exercise control, but also add value as they "not only filter and select information but also qualitatively alter the informational content through active accumulation, processing and packaging" (Ballon, 2009a). In the context of mobile service platforms, Ballon (2009b) concludes that gatekeeper roles are crucial in developing strategies which expose information resources and thereby attract customers, while controlling and locking-in various types of customers.

In summary, the approach proposed in this study follows a qualitative approach based on desk research, document analysis and expert interviews. The VCDWG will be adapted to address the referred shortcomings and will hence consist of the following steps:

1. Analysis of online video services towards the definition of a taxonomy of the current state of online video services and the identification of a generic value network, main roles and actors, based on expert interviews and desk research, including existing studies, literature and data from various sources;

2. Identification of positions of sustainable power using control points based on conducted expert interviews and existing case studies and literature;

3. Enumeration of varying business model configurations through gatekeeper roles, exemplified by real online video services;

4. Identification of technological, regulatory, social and business triggers that may impact the dynamics of power and control, through inputs from expert interviews and an overview of Future Media Internet research;

5. Capture the potential changes caused by triggers in a number of scenarios, through the evaluation of the importance and impact of triggers. Together with the scenarios, identify potential changes to business model configurations and policy considerations that could balance the dynamics between business actors.

3.2 Qualitative Approach

This study is exploratory in nature and takes a qualitative approach to uncover transformations in a converged sector still evolving and immature, which is further impacted by permanent technological and architectural changes. Analysing the current state of online video services is not a light task, as it unveils different types of services provided by different stakeholders, sometimes competing, sometimes collaborating, but in essence making available the same content to the same audience, one that values content to be available anywhere and anytime.

Although traditional players are largely present and are still trying to impose old industry practices, it is important to gain a holistic overview of the industry's context in order to derive an understanding of the dynamics of power and control in the interactions between the actors involved in online video service innovation. A qualitative approach allows researchers to gain such holistic perspective and derive fruitful explanations (Löblich and Pfaff-Rüdiger, 2012). Moreover, good qualitative data allow researchers to go beyond initial conceptions and revise conceptual frameworks (Miles and Huberman, 1994).

Therefore, this study encompasses a combination of a structured methodology with qualitative methods, including document analysis and expert interviews, to inform the researcher about the current state of play aiming at an understanding of the determinant factors that may impact further transformations. This qualitative analysis is also historically aware, as many legacy contingencies of the film and TV industries are impacting the institutional and strategic context of online video service innovation. Desk research, document analysis and expert interviews formed the unit of analysis of this research and were used as input to the qualitative analysis as well as in the steps of the adopted methodology.

3.3 Desk Research and Document Analysis

Qualitative research includes data collection through a wide combination of methods such as interviews, historical analysis, document and textual analysis, sociometry, and ethnographic research (Berg and Lune, 2012). Data collection was partially based on desk research and document analysis of the online video services landscape in Europe and in the U.S., including existing studies, market reports, official reports (by or commissioned by e.g. European Audiovisual Observatory, European Commission, Federal Communications Commission, ITU), white papers and positions papers around the topics of VOD, OTT, TV Everywhere, online TV, online video, connected TV, video programming, cord-cutting. As there is significant mainstream media coverage on these topics (specially in the U.S.), it was also deemed necessary to confront information from a variety of news websites, press releases and expert blogs. Websites and publicly available information about a number of existing services were also scrutinised in order to inform and cross-check findings from expert interviews, but also to categorise services, identify revenue models, types of content available, technical features, etc.

In the case of Future Internet and Future Media topics, a number of project reports, position papers, standardisation documents and scientific papers were reviewed. In addition, meeting minutes of several working groups and task forces were thoroughly analysed to infer the primary contributors to research and standardisation developments.

3.4 Interviews

As Hollifield and Coffey (2006) suggest, "interviews are a crucial data collection method in media management and economics research, primarily because very few corporate "elites" will consent to respond to telephone or mail surveys". In this study, expert interviews were crucial and the main contributor to the methodology, in particular to identify and continuously refine the main business roles and actors of the value network and identify relevant control points. The generic value network and a number of business model configurations were validated and discussed in several interviews. In addition, interviews also contributed to perceiving the dynamics behind control points, i.e. how could these change in the future, hence conducing to the identification of triggers and singling out the uncertainties used to construct the scenarios.

A total of 42 people were contacted, in order to arrive at a final set of 19 representatives with which an interview could be scheduled. Representatives from companies primarily based in the U.S. revealed extremely difficult to contact. However, from several companies with an international presence, it was possible to contact an European representative. The aim was to interview at least two representatives for each type of actor in order to gather diverse viewpoints. However, some actor types are not duly covered. Interviewed experts hold a managing position with a good view and understanding of the firm's strategy, competing firms and the sector. Nevertheless, it was clear that some interviewees had a better perspective of the complex ecosystem than others. About half of the interviewees were concerned with confidentiality issues and four clearly expressed they could not provide corporate confidential information, although they were not asked for such information. Interviews were conducted between October 2014 and early April 2015 using theoretically informed and semi-structured format. Four interviews were conducted in person and the remaining were conducted over Skype or phone, in Portuguese, English and French. Prior to each interview, experts received a brief introduction to this research and were asked for a thirty minutes to one-hour talk. However, many interview sessions lasted for more than one hour, since many experts reflected expansively on many of the sector's business concerns and challenges, and the future of media. Interviews were semi-structured and contained preset questions (see Annex A), but a number of questions were added as appropriate in order to gather insights on new findings, to validate and cross-check findings collected in previous interviews and to verify derived results from the applied methodology. Therefore, the validity of results was verified in subsequent interviews with a number of interviewees.

Table 3.1: List of interviewees.

Job Title	Organisation Type
Director for New Media Development	Public Broadcaster
Senior Project Manager, TV and Mobile Applications	Public Broadcaster
Director Digital Services and Multimedia	Public Broadcaster
Senior Project Manager, Technology & Innovation	Union of Public Broadcasting Organisations
Content Delivery and Video Transport Sales Engineer Manager	Global Transit Operator and CDN Provider
CTO	Global Pay-TV Operator
Head of Multiplatform TV Service	Pay-TV Operator
International Relations Manager	European VoD Service Provider
Co-founder	European VoD Service Provider
CTO	European VoD Service Provider
Digital Licencing Manager	Major Movie Studio
VP, Technical Sales Support	Global Online Video Platform Provider
Co-founder	Online Video Platform Provider
COO	Internet Exchange Point Operator
Director of Interconnection	Internet Exchange Point Operator
Business Director	Large Scale Streaming Solutions Provider
Research Engineer	Standards Development Organisation National Representative
Project Officer	European Union Institution
Film Industry Analyst	Advisory European Union Institution

Table 3.1 summarises the profiles of the study's interviewees. Because of confidentiality concerns, firm names are not indicated and no quotations will be made throughout this study, in order to ensure that statements cannot be linked to a specific person. For the same reason, references to interviewees will not be used in this text.

In addition to expert interviews, this study also benefited from informal talks with peers, colleagues and industry stakeholders at conferences, seminars, and a summer school. It is worth highlighting that a study gathering 19 opinions cannot claim to be sufficiently exhaustive, but it does provide interesting insights about the current state of play and can inform future studies.

3.5 Value Network Analysis

Value network analysis is a generally accepted technique from industrial organisation theory, which builds further on Porter's concept of value chains (Porter, 1980, 1985). Within theories of the firm, value chain analysis was developed in order to identify and build upon areas of competitive advantage by examining value adding activities within and across an organisation. The concept of value chain analysis was broaden up to enable analysis across firms and became the dominant framework for analysing value creation and portraying the chained activities within manufacturing and other traditional industry sectors (Kaplinsky and Morris, 2001).

However, the value chain framework has given way to the use of value networks, as the first concept in the current's business context becomes increasingly inappropriate to analyse industry sectors and the dynamics of value creation, co-operative behaviour and inter-firm relationships (Nielsen, 1988; Normann and Ramirez, 1993). As Normann and Ramirez (1993) contend "(...) strategy is no longer a matter of positioning a fixed set of activities along a value chain. Increasingly, successful companies do not just *add* value, they *reinvent* it. Their focus of strategic analysis is not the company or even the industry but the *value-creating system* itself, within which different economic actors – suppliers, business partners, allies, customers – work together to *co-produce* value. Their key strategic task is the *reconfiguration* of roles and relationships among this constellation of actors in order to mobilize the creation of value in new forms and by new players." (original emphasis).

In analysing a value network, the primary question to be answered is the same as in value chain analysis: "How is value created?". However, the key to value creation in value networks is established by the relationships between firms and the competitive environment arising from the network of relationships (Anderson, 1995). The performance of value networks is evaluated on how the whole system of these activities and inter-relationships contributes to deliver value to the customer (Fjeldstad and Ketels, 2006). Based on these premises, a number of scholars have used the value network conceptualisation to show that the ICT industry has evolved from a value chain into a value network (Peppard and Rylander, 2006; Li and Whalley, 2002; Funk, 2009; Pagani and Fine, 2008). In addition, value networks have also been used as a means of illustrating where economic power is located in mobile telecommunications services and platforms through bottlenecks and gatekeeping functions (de Reuver and Bouwman, 2012; Ballon et al., 2008; Ballon, 2009a; Ballon and Walravens, 2008; Gonçalves et al., 2010).

The value network mapping technique relies on the integration of a network of firms and the exchange of tangible and intangible value, in the forms of financial flows and data and service flows. In the context of this study, business models are examined in terms of value streams as well as points where control is exerted between a set of abstracted entities. These entities include roles, actors and stakeholders, and exchanges of services and financial flows are considered. A business role is a discrete set of responsibilities, actions, activities and authorisations that together have a coherent value-adding logic. A business actor is an active marketplace entity, which integrates one or more roles. A stakeholder can be defined as a current real-life organisation (a specific individual, institution, company, etc.) with an interest or stake in the outcome of a certain action (Ballon et al., 2008). In the examples presented in this study, business roles are shown as white rectangles, business actors as grey rectangles, stakeholders' names are presented above business actors' rectangles (see Figure 3.2). Service flows are depicted as black arrows, while financial flows are depicted as white arrows.

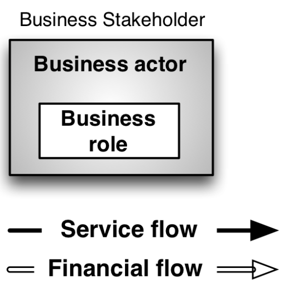


Figure 3.2: Main design elements for value network analysis.

By using these design elements, business models can be analysed outlining the main roles and the relevant actors. Moreover, the relationships between actors can be identified in terms of revenue sharing, service provision and control over crucial value-adding roles. Depending on the business model, the roles each actor plays may shift, according to which actor controls most of the value-adding activities. Finally, stakeholders can be mapped onto the generic business models, revealing how real-life market entities undertake actor activities (Ballon et al., 2008).

3.6 Business Modelling Analysis

Although there were earlier mentions of the term, Hawkins (2004) posits that the term business model emerged in the 1990s along with the dot.com bubble. Therefore, early approaches to business modelling were mostly concerned with e-commerce related revenue models or value propositions (see e.g. Tapscott et al. (2000); Timmers (1998); Slywotzky (1996)). Ballon (2009a) argues that as the bubble burst, attention has shifted towards the integration of ICT-driven possibilities into existing business configurations, in part caused by the increasing convergence between ‘traditional’ telecommunications and the Internet. As a result, the emphasis of business modelling on a single firm has gradually shifted to a network of firms and to a broader scope comprising concepts such as value network, functional architecture, financial model, and value proposition (Ballon, 2009a).

Another wave of business modelling analysis has focused on empirically illustrating the impact of business models on a firm’s performance, serving as a basis for business case simulations (see e.g. Pigneur (2003); Osterwalder (2004)). Similar concepts were also being developed by a group of scholars based in The Netherlands, but whose focus was on the value generated among networks of organisations and how this construct supported multi-stakeholder innovation projects in the mobile sector (see e.g. Bouwman et al. (2008); Faber et al. (2003); Maitland et al. (2005)). Following this, Hawkins (2004) would define a business model as the way in which a firm or a set of firms intend to create and capture value with a product or service by linking new technological environments to business strategies.

More recent work has intended to incorporate issues of control in a multi-firm network and has shifted the focus to who controls the value network and the overall system design (e.g. Ballon (2007); Chesbrough (2006)). In particular, Ballon (2007) contends that it is the alignment of control and value parameters that is of most relevance to business modelling.

Ballon (2009a) has operationalised this approach into four levels in which business models operate and identifies three critical design parameters on each level. They encapsulate the dimensions of value creation on the one hand (which relates to aspects such as the value proposition and the financial model), and the dimension of control on the other hand (relating to the outset of the value network and the functional architecture). These four levels represented in the business model configuration matrix (BMCM) (Figure 3.3) consist of: the value network level (i.e. the architecture of actors and roles in the future marketplace), the functional model level (i.e. the architecture of technical components in the future technological system), the financial model level (i.e. the architecture of financial streams determining the future business case), and the value proposition level (i.e. the architecture or general outline of the future product or service).

CONTROL PARAMETERS				**VALUE PARAMETERS**			
Value Network Parameters		**Functional Arch. Parameters**		**Financial Model Parameters**		**Value Configuration Parameters**	
Combination of Assets		Modularity		Cost (Sharing) Model		Positioning	
Concentrated	*Distributed*	*Modular*	*Integrated*	*Concentrated*	*Distributed*	*Complement*	*Substitute*
Vertical Integration		Distrib. of Intelligence		Revenue Model		User Involvement	
Integrated	*Disintegrated*	*Centralised*	*Distributed*	*Direct*	*Indirect*	*High*	*Low*
Customer Ownership		Interoperability		Revenue Sharing Model		Intended Value	
Direct	*Intermediated*	*Yes*	*No*	*Yes*	*No*	*Price/ Quality*	*Lock-in*

Figure 3.3: Business model configuration matrix (Ballon, 2007).

Regarding control parameters, these are value network parameters and functional architecture parameters. The atomic parameters all represent a trade-off. They are as follows:

- Combination of assets: considers the distribution of assets over the actors in the value network. These assets can be essential or generic, and can be concentrated or dispersed over the different actors.

- Vertical integration: considers the trade-off between integrated and disintegrated value chains and networks.

- Customer ownership: not all value network actors have a direct relationship to the end-customer. This is an essential role as it provides the value proposition(s) of the service or product, and sets the level of intimacy of customer ownership that can be exercised.

- Modularity: refers to the discrete modules that can make up a system design, and in terms of functional architecture deals with the trade-off between a modular design and production versus an integrated or interdependent design and production.
- Distribution of intelligence: the trade-off between centralised and distributed intelligence is an architectural concept that impacts the business and organisational design.
- Interoperability: refers to the direct information and service exchange between systems, and related to the trade-off between open and proprietary solutions.

Regarding value parameters, these include financial model and value configuration parameters:

- Cost sharing model: relates to how the costs for offering the product or service are shared amongst actors. The trade-off here is between investments and costs being concentrated with one actor, or distributed over various.
- Revenue model: similarly to costs, this parameter determines how the revenues are generated. The trade-off is between direct (customer generated) and indirect (advertiser, subsidiser generated) revenues.
- Revenue sharing model: refers to agreements on whether and how to share revenues amongst the actors involved in the value network.
- Positioning: the market position of a product or service is a complex issue that deals with several trade-offs that can be brought down to deciding whether to position it as a complement or a substitute of certain existing products and services.
- User involvement: refers to the degree of user involvement in the value-creation process, i.e. to which extent are users just consumers rather than prosumers of content and services.
- Intended value: a triple trade-off should be made for intended value, between operational excellence (which reflects the price of the product or service), product leadership (which relates to the quality) and customer intimacy (custom-made solutions and lock-ins).

As already mentioned, this ontology will be adopted throughout this study in order to evaluate and categorise the control points and derive business model configurations.

3.7 Scenario Building

Reflecting upon future trends and forecasting potential market changes have become part of any firm's forward-looking business strategy aiming at competitiveness. Scenario planning is suggested as an instrument to help dealing with uncertainty, while supporting decision-making (Varum and Melo, 2010). Although scenarios cannot provide an accurate characterisation of the future, they help reflecting on and identifying trends and uncertainties one is likely to deal with in the future. Hence, scenarios present alternative representations of the future or, as Martelli (2001) puts it, "a few different possible future outcomes for the situation under scrutiny". As Varum and Melo (2010) analysed, there are several strands of scenario building methods but they hold a common feature — they are quite flexible and can be adapted to different contexts. Traditional scenario planning methods mostly rely on developing narratives, sometimes based on a number of uncertainty factors, and then on assessing each scenario for their key drivers and success factors. In other evolutionary tracks, Pateli and Giaglis (2005) propose a methodology for scenario building in the context of studying business models evolution under the influence of technology innovation. Towards the goal of designing a set of alternative future business models in the form of scenarios, Pateli and Giaglis (2005) take as inputs the benefits and impacts that a given technological solution brings to key elements of the business model and build scenarios which propose different cooperation and responsibility schemes between new and existing players in the new business environment. Also in the context of business ecosystem network analysis, Battistella et al. (2013) propose a methodology to analyse the current business ecosystem and study its evolution. In order to study the business ecosystem evolution, a number of trends and uncertainties are identified, the two most critical uncertainties (with highest level of uncertainty and highest level of impact) are selected, and a narrative is defined for each intersection between the two uncertainties.

In this study, the approach for scenario building will lie at the intersection between the methodologies proposed by Battistella et al. (2013) and Pateli and Giaglis (2005). First the importance and impact of the social, technological, business and regulatory triggers derived in the fourth step of the methodology will be mapped. The triggers with highest importance to multiple actors and highest impact on the future development of online video services will be selected to constitute the uncertainty factors in the context of Future Media. The scenario narratives will be based on these uncertainties and will take into consideration the potential changes to the control points in that context. For each scenario, the dynamics of the market, services' characteristics, and changes to the business model configurations and gatekeeper roles will be discussed.

3.8 Conclusion

The approach proposed in this study is based on the VCDWG methodology and follows a qualitative approach based on desk research, document analysis and expert interviews. As the VCDWG methodology presents several shortcomings, these will be addressed by:

- focusing on value networks instead of value chains;
- examining business models across a sector and for specific types of services, and, if relevant, consider to put particular emphasis on groups of actors;
- evaluating control points beyond centralised vs. distributed aspects of control points;
- grouping control points around gatekeeper roles, instead of control points constellations.

Therefore, the proposed methodology will consist of the following steps as depicted in Figure 3.4:

1. Analysis of online video services towards the definition of a taxonomy of the current state of online video services and the identification of a generic value network, main roles and actors, based on expert interviews and desk research, including existing studies, literature and data from various sources;
2. Identification of positions of sustainable power using control points based on conducted expert interviews and existing case studies and literature;
3. Enumeration of varying business model configurations through gatekeeper roles, exemplified by real online video services;
4. Identification of technological, regulatory, social and business triggers that may impact the dynamics of power and control, through inputs from expert interviews and an overview of Future Media Internet research;

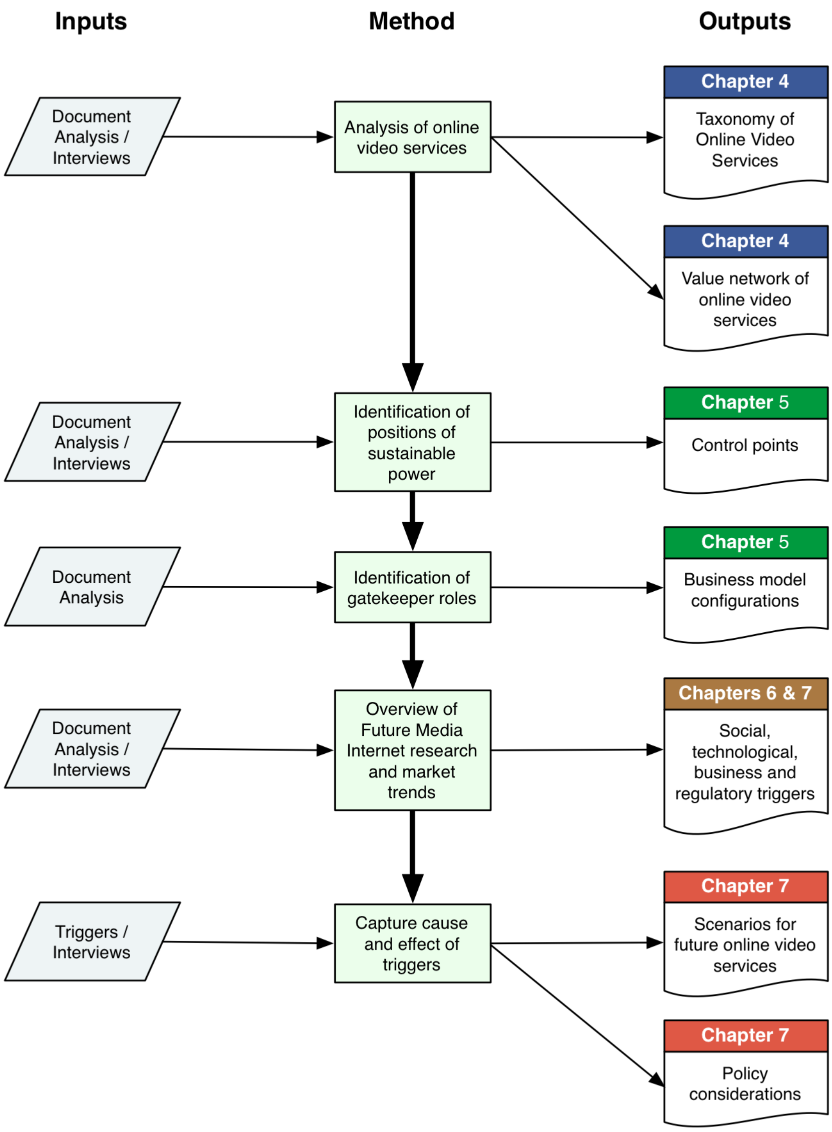


Figure 3.4: Steps of the methodology proposed in this thesis and corresponding chapters.

5. Capture the potential changes caused by triggers in a number of scenarios, through the evaluation of the importance and impact of triggers. Together with the scenarios, identify potential changes to business model configurations and policy considerations that could contribute to balance the business dynamics between actors.

The following chapter addresses the first step of the methodology and will analyse the current state of online video services.

Chapter 4

Online Video Services

This chapter intends to provide an overview of the current state of online video services, contemplating inputs gathered from expert interviews, towards the goal of defining a taxonomy as part of the first step of the adopted methodology. Services available in the U.S. and European markets, related and unrelated with the interviewees, were chosen to put in evidence the broad range of service characteristics, trends and strategies employed by the main actors involved in online video services provision, and ultimately, to highlight distinctive service features/characteristics as the basis for the construction of a taxonomy.

Although the services overviewed in this chapter could fit under the buzzword Over-The-Top (OTT) video, in this study the term online video services is preferred. On the one hand, in literature and media coverage, the term OTT service is often used to refer to services delivered over the network operator layer including not only video but also other services such as Skype and WhatsApp. On the other hand, the concept OTT video is often referred in literature to video delivery by an Internet platform (e.g. Hulu, Netflix) that controls content distribution, but which differs from a traditional gatekeeper, a broadcaster or an ISP/telecom operator (Henten and Tadayoni, 2012; EC, 2013). Nevertheless, OTT services piggyback on an Internet broadband provider's network for delivery[1]. While considering the European Audiovisual Media Services Directive (AVMS), most of the OTT video services would thus fit under the definition of on demand (i.e. non-linear) audiovisual media service as a service "provided by a media service provider for the viewing of programs at the moment chosen by the user and at their individual request on the basis of a catalogue

[1]For a discussion on the ambiguity of OTT definitions, check Grece (2014, p. 13).

of programs selected by the media service provider" (EU, 2010, p. 12). AVMS also defines media service provider as "the natural or legal person who has editorial responsibility for the choice of the audiovisual content of the audiovisual media service and determines the manner in which it is organised", which may or may not encompass new players which differ from broadcasters or ISPs. As acknowledged by the European Commission's Green Paper on Preparing for a Fully Converged Audiovisual World, the AVMS needs to be updated to reflect new services and market conditions. The Green Paper discusses "the progressive merger of traditional broadcast services and the internet" and the way they are consumed and delivered, while referring to OTT players as providers of "online audiovisual content without themselves being electronic communications services and network providers" (EC, 2013, p. 3). There are currently many examples of traditional TV broadcasters and pay-TV operators (over cable, satellite, IPTV etc.) making vibrant efforts to also bring live broadcasting (i.e. linear TV) to the online context in order to compete with new Internet players. Therefore, the online video landscape is not only composed of these new players, but also of the traditional ones, which are using the Internet as a new distribution stream. We believe the term OTT video is continuously used to refer to all sorts of video services because it became a buzzword, but in fact it is no longer representative of the myriad of services which can be delivered over the Internet. Hence, the pertinence to propose a new term.

Therefore, throughout this study, and unless otherwise specified, online video services refer to generalised video delivery using the Internet Protocol (IP) over a public network, i.e. the Internet with unmanaged Quality of Service (QoS). The focus lies specifically on free or paid services, which distribute professionally produced content[2], independently of the technological platform and the type of player (broadcaster, pay-TV operator[3], Internet player, etc.) the customer builds a

[2] In contrast with user generated content, which is typically produced by users of an online service, not encompassing professional practices and outside of a business network made of suppliers and providers. By narrowing the scope to professionally produced content, video sharing platforms such as Vimeo or DailyMotion, which offer user generated content are excluded from this definition. However, it is hard to exclude YouTube, since over the past years and during the course of this research, professionally produced content has also been added to the platform through, at least, four new services/initiatives. YouTube Original Channel Initiative launched in 2012 funded about 160 professional channels based on content produced by emerging native digital content creators and Hollywood producers. In January 2015, YouTube announced it would fund during 2015 top native YouTube talent to produce new programming concepts (Wallenstein, 2015). YouTube Live is dedicated to stream major live events, such as the London Olympic games. In 2012, YouTube reported that 231 million live streams of the Olympics had been watched worldwide. YouTube provided free coverage of the Olympics in 64 African and Asian countries (Webster, 2012). The YouTube partners program allows content creators meeting certain criteria to monetise their content through ads, paid subscriptions and merchandise. Finally, YouTube Movies service has been created in a partnership with Universal Movies, Sony Pictures, Disney and WarnerBros.

[3] In the United States, as per the Telecommunications Act, a pay-TV operator is referred to as a multichannel video programming distributor (MVPD).

relationship with. By limiting the scope to the public network, services such as IPTV over service providers' private or managed networks are therefore excluded. As such, for the purpose of this study, online video services[4] to be analysed include:

- Internet Video on Demand[5] (VOD) services, which allow viewers to stream content on demand at their request. Consumers normally access a catalogue of films and TV series using an app or through a web portal. Access to content may be free, on a subscription basis, on a rental basis, or to own permanently;

- live and catch-up linear TV content and channels streaming platforms, which stream linear TV (the predictable schedule of a television channel at the time it is offered), both on live mode or on catch-up mode (content can be accessed up to a limited number of days after it has been aired). Viewers can access content through a web portal or using an app;

- TV Everywhere (TVE) services[6], which are pay-TV operators' authenticated aggregation of linear television programming and VOD content made available to viewers as part of their paid subscription. These services are offered on the operators' web portal or via an app.

Most of these services compete for the same audience and rely on the same professional content supplied by traditional content producers and content distributors, consisting predominantly on an aggregation of free-to-air and commercial TV content. In addition, VOD and catch-up services provide films, series, sports events and specific TV-programs from premium/paid broadcast networks. It is also worth clarifying that access to these services is made via web browsers or dedicated apps on tablets, smartphones, game consoles, Blu-ray players, PVR/DVRs, personal computers or smart/connected TVs[7]. In addition, a number of digital media players (e.g. Apple TV,

[4]Although considered initially in the setup of this study, place-shifting services have not been addressed further as their initial study revealed a high-level of immaturity and volatility. The results of the initial study are provided in Annex C.

[5]Pay-TV operators also offer VOD content over their managed TV platform and infrastructure. Pay-TV VOD is not considered here as it is not delivered over the unmanaged Internet.

[6]The TV Everywhere concept was jointly announced by U.S. cable providers Comcast and Time Warner in 2009 and refers to pay-TV operators' authenticated aggregation of linear television programming for free (as part of the subscription) (Waterman et al., 2013; Ulin, 2014). It allows for validation of the subscribers and their corresponding subscribed services, and gives access to TV programming on a variety of fixed and mobile Internet-connected devices. Thus, this service does not substitute a pay-TV subscription, but rather requires one.

[7]Definitions of smart TV, hybrid TV and connected TV abound (Scheuer, 2013; OECD, 2014; Grece, 2014). In the scope of this work, connected TV or smart TV refer to the integration of Internet services and a multitude of audiovisual content, services and applications coming from several sources, which are delivered to and consumed via a television set on one screen.

Google Nexus Player, etc). and set-top boxes (usually made available to the consumers through pay-TV operators) are also a gateway between the TV-set and online video services. In order to address each and every platform, specific applications or widgets are made available by service providers.

The following first and second sections provide background data about the market transformations occurring around digital content, showing evidences of consumption changes and online video services reach. Most data made available in institutional and market research reports is, however, often either focused on the U.S. or European markets, hence the difficulty in presenting consolidated and comparable data for both markets. Section 4.3 presents a brief overview of the typical digital video workflow, as well as the dominant technologies for encoding, streaming and enforcing commercial licencing rights through digital rights management (DRM). The stress on encoding, streaming and DRM technologies is justified by the facts highlighted by the interviewees: choosing and adopting these technologies represent a high cost for online video service providers both in licencing and in app development, as the compatibility matrix between end-user devices and technology (i.e. which device supports each technology) is quite sparse. Section 4.4 presents a generic value network derived via an iterative process of feedback obtained in expert interviews. This value network intends to represent the current market state and relationships for online video services. Business roles, business actors and revenue models related with the current state of play of online video services are examined in Sections 4.4 and 4.5. Section 4.6 discusses examples of two types of strategies — competitive alliances and collaborative ventures — several stakeholders have been involved in, in order to strengthen their current market position and to compete with established players or new entrants. Finally, in the last section, a taxonomy of online video services is presented, as part of the first step of the adopted methodology.

4.1 Digital Media Usage Trends

In order to enrich the background knowledge on the market transformations occurring around digital content, TV and Internet consumption, this section introduces a collection of data pertaining to digital content consumption. The data focus is on the viewer and consumer of digital content but elicits implications on the expanding market audience of online video services.

Broadband penetration is having a great repercussion on ubiquity and on simplifying the way users perform activities online, such as e-banking, e-commerce, news reading, email, social networking, etc.. The use of mobile devices to access the Internet and digital content has seen rapid increase around the world over the past five years, with steeper growth happening in Africa and Asia. Mobile Internet usage as a percent of Web usage is rapidly rising, as set forth in the comparison between 2013 and 2014 in Figure 4.1.

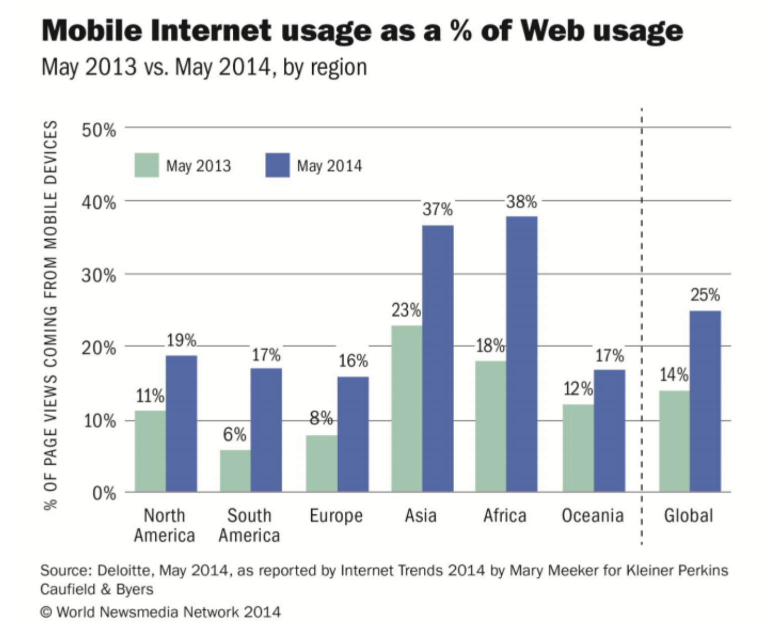


Figure 4.1: Mobile Internet usage as a percentage of Web usage, May 2013 versus May 2014 (WNMN, 2014).

As a consequence, browsing behaviour is changing from PCs to mobile devices and the latter are often found to be the preferred devices to browse and watch digital content. In the same way, the number and range of available connected devices which can play video in a fairly good screen has largely increased. As the options diversify, viewers are no longer limited to their TV-set. As reported by Ericsson in 2012, viewing habits have not moved away significantly from the TV (see Figure 4.2), but the total number of hours spent on other devices supersedes the number of hours of TV-set usage.

Consumers are moving from *passive* viewing to *active* viewing valuing flexibility and conveniency, with multi-device access, when and where they want. It can also be observed that viewer behaviour is changing from casual to a binge consumption approach, where viewers watch multiple episodes of a TV-show in one sitting[8]. It comes with no surprise, that younger generations are the first to embrace new digital media devices and tools. For instance, as shown in Figure 4.3, mobile phones and tablets' early adopters are among the younger generations (between 16 to 34 years old) and among mid to high-income earners.

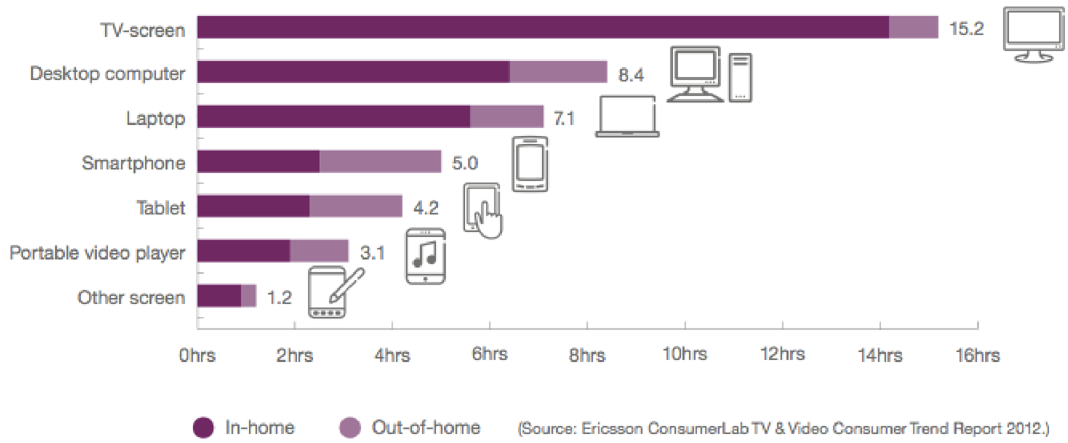


Figure 4.2: Average amount of viewing hours per device per week, both in- and out-of-home in 12 countries (U.S., UK, China, Spain, Sweden, Brazil, Taiwan, South Korea, Germany, Mexico, Chile and Italy) (Ericsson, 2012).

Besides devices with a screen, there is also a great choice of other devices — digital media players, game consoles, DVRs, PVRs, DVD and Blu-ray players, HDMI dongles, and STBs — which facilitate access to online content and services and serve as interface between online video supply and the TV-set. Such devices include, among others, Roku media player, Apple TV, Google's Chromecast, Amazon's Fire TV, Sony's PlayStation and Microsoft's Xbox. Strategy Analytics reported a global installed base of connected devices[9] of about 500 million in the second quarter of 2014, an increase of 34 percent compared to the same period of 2013 (PRNewswire, 2014). Table 4.1 shows a breakdown of the global installed base of connected devices per vendor. According to the same source, the second quarter of 2014 marked the first time that the number of Smart TVs installed in homes surpassed the number of IP-enabled game consoles. In conclusion, as alternatives modes of consumption become part of consumers' everyday life, the marketplace for

[8]Netflix conducted a survey in 2013 among 3078 U.S. adults, which revealed that 61 percent of those who watch TV shows online engage in binge-watching 2-3 episodes at least every few weeks (Spangler, 2013).

[9]Strategy Analytics defines connected devices as being smart TVs, smart Blu-ray players, IP-enabled game consoles and digital media streamers.

new devices is both booming and fragmenting, imposing new pressures on online video service providers to reach the widest possible audience.

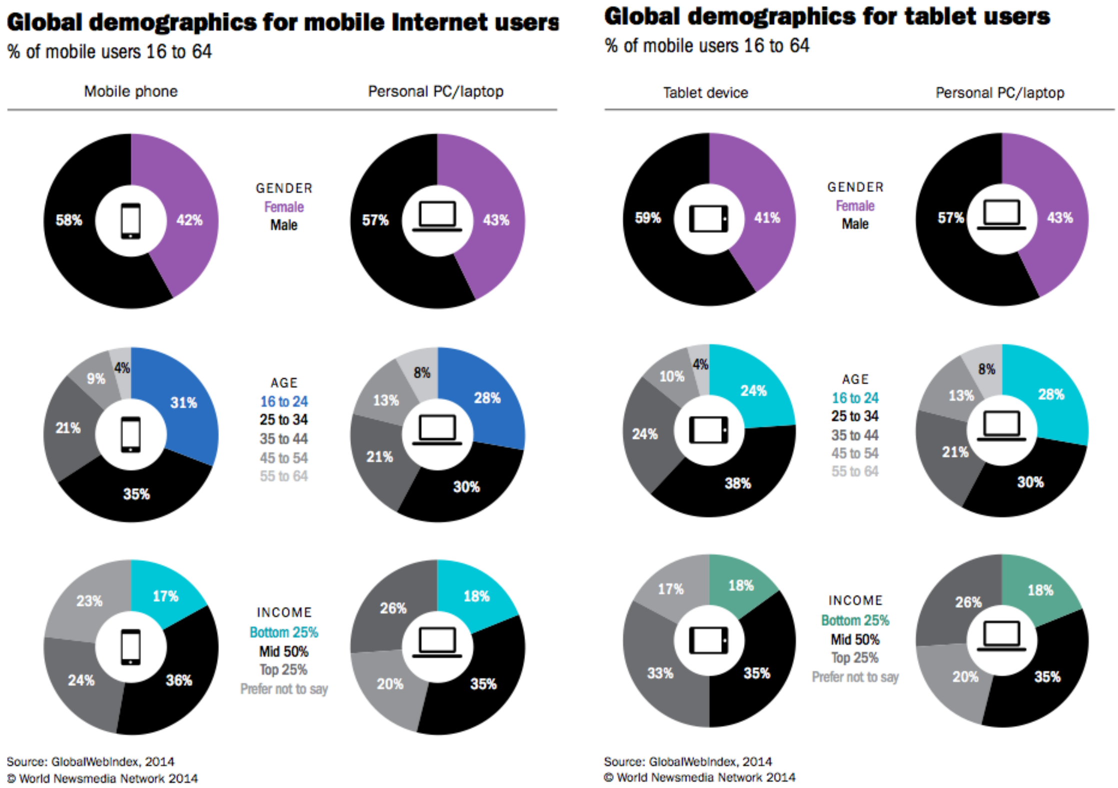


Figure 4.3: Global demographics for mobile Internet and tablet users, 2014 (between 16 and 64 years old) (WNMN, 2014).

Table 4.1: Global connected devices installed base (million units) (Strategy Analytics cited in (PRNewswire, 2014)).

Q2 14 Rank	Vendor	Q2 14	Q2 13	Q2 14 Share	Q2 14 Installed base growth (YoY)
1	Sony	123.8	96.8	24.8%	27.9%
2	Samsung	62.3	34.4	12.5%	80.9%
3	Nintendo	56.8	67.5	11.4%	-15.8%
4	Microsoft	55.4	53.8	11.1%	2.9%
5	LG	32.2	16.0	6.5%	101.9%
6	Panasonic	29.9	19.6	6.0%	52.4%
7	Apple	18.7	13.0	3.8%	44.7%
8	Sharp	15.0	9.8	3.0%	52.7%
9	Toshiba	10.2	5.1	2.0%	98.8%
10	Philips	9.7	5.7	1.9%	70.0%
11	Roku	8.3	5.5	1.7%	51.9%
12	Google	6.0	0.0	1.2%	na
Note: Connected TV devices include smart TVs, smart blu-ray players, games consoles and digital media streamers					

4.2 Market Trends

The convergence between traditional linear TV and Internet along with mobility and improved broadband connections are transforming the way viewers consume traditional TV content and content produced specifically for online platforms (e.g. House of Cards). Online video consumption has been growing over the past years, with Internet video alone representing 66 percent of consumer Internet traffic in 2013 and expected to increase to 79 percent by 2018 (Cisco, 2014). Although user generated content websites, like YouTube and Vimeo, are the most popular video platforms, viewers are increasingly looking for professional content on legitimate online services, reaching for a TV-like experience.

Market reports contend viewers are watching less TV in the traditional setup (linear TV on a TV-set), preferring to timeshift TV with their set-top box or watch TV on digital devices such as smartphones, tablets and PCs. As shown in Figure 4.4, time spent watching traditional TV is slowly being spent on other platforms. Traditional TV is not over, but viewers are reaching out for more personal and unique viewing experiences and one can expect the consumption trend to lean faster towards online video services. Similarly, consumer spending on cinema box-office, DVD and Blu-ray sales and rental has been decreasing over the past five years (Grece et al., 2015).

Market shares for a number of services show a growth trend of online video services over the past years. As consumer habits change, viewing experience improves and services become more competitive, online video services are deemed to substantially play a big role as an alternative mode of TV consumption in the future.

The rise and success of VOD services have prompted pay-TV operators to provide remote access to subscription services on devices other than the set-top box, such as PCs, tablets and smartphones. This remote access, also known as TV Everywhere (Waterman et al., 2013) includes access to linear and time-shifted TV channel schedules (catch-up), premium channels and premium VOD content, such as films or TV series, and other functionalities such as second-screen or multi-screen experiences. This enhanced experience results from pay-TV operators' wish to consolidate the value of pay-TV subscriptions and defend themselves from online disruptive services. According to PwC (2014), 2013 has seen pay-TV subscriptions (over cable, satellite and IPTV) in both the U.S. and Canada declining. This decrease, although still rather limited, can be associated with a phenomenon often called 'cord-cutting'. Although many pay-TV customers have cancelled their

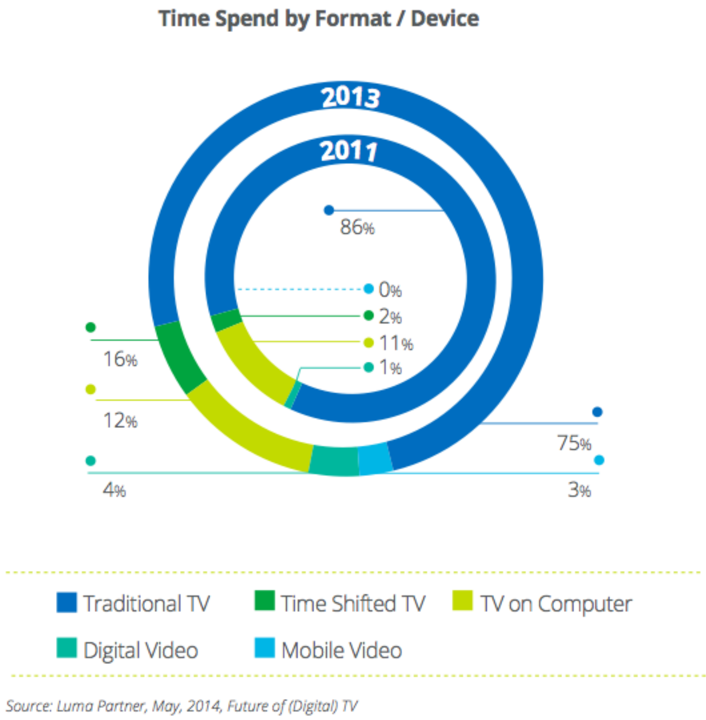


Figure 4.4: Comparison of time spent watching content by format/device in 2011 and 2013 (Google, 2014).

subscriptions to presumably rely on online video services instead, a significant number of pay-TV customers have transited to higher-priced services, and consequently, TV subscription spending is continuing to rise. The cord-cutting phenomenon is however less noticeable in Western Europe, with pay-TV subscriptions and TV subscription spending continuing to increase (PwC, 2014). For the U.S. market, Adobe (2014) reports a share of 12.5 percent of pay-TV subscribers actively viewing TV Everywhere content in the last quarter of 2014, almost doubling the amount of viewers for the corresponding quarter of 2013 (Figure 4.5).

Further evolutions of the traditional pay-TV offerings are anticipated, with several key players, such as BSkyB and Dish Network, already exploring new pricing schemes and bundles as low cost alternatives to pay-TV. Sky's Now TV offers three types of live TV monthly passes (films, sports and entertainment) giving access to a selection of Sky's and other pay-TV channels, to be consumed over the Internet on mobile devices or on the TV-set with a branded STB. Dish Network's Sling TV is very similar, giving access to a selection of 16 channels and additional thematic channels (sports, kids, Hollywood, etc.) for an extra fee. The service also allows catch-up in the following 3 days

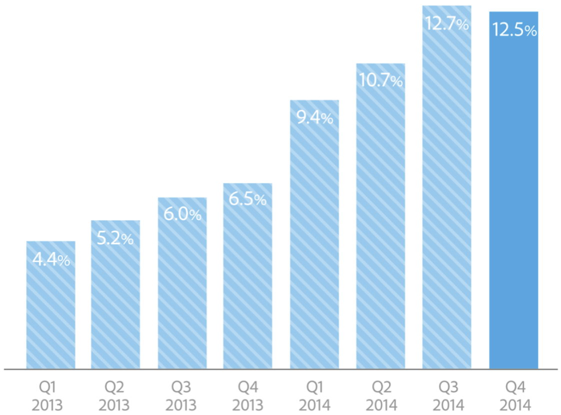


Figure 4.5: U.S. pay-TV share of active TV Everywhere viewers (2013 - 2014) (Adobe, 2014).

and supports a number of end user devices which connect to the TV-set (Katzmaier, 2015).

With pay-TV not significantly declining and VOD services currently enjoying a fast growth, the two types of services appear to be complementary to the consumer, rather than VOD substituting pay-TV. Netflix, considered an upstart amongst online video service providers and one of the leading VOD Internet platforms, reported that its subscribers streamed more than 10 billion hours of video in the first quarter of 2015 (Bradwell, 2015). Over the past years, Netflix has grown to over 62 million subscribers worldwide in over 50 countries, with U.S. amounting alone 40 million subscribers (Bradwell, 2015). Hulu, competing side by side with Netflix for the U.S. market, announced its subscriber base had reached nearly nine million of subscribers in the first quarter of 2015, representing a 50 percent increase since 2014. Moreover, Hulu also reported users consumed over 700 million hours of premium content, representing an increase of 77 percent in total streams (Hulu, 2015). According to Strategy Analytics's ConsumerMetrix survey, during the last quarter of 2014, half of U.S. pay-TV subscribers watched Netflix, while 23 percent watched Hulu (Kawasaki, 2015).

Cunningham and Silver (2013) list the key milestones in the evolution of the U.S. market for VOD (film and TV content) via the Internet between 1997 and 2013 and outline three waves of market development, inspired on industry lifecycle theory characterised by fragmentation, shakeout, maturity and decline stages. The first wave, between 1997 and 2001, was characterised by pioneer firms, ahead of their time, small and under-capitalised, which were quickly acquired or went bankrupt. The second wave can be divided in two shakeout periods. The first, between 2001 and

2006, occurred when the Hollywood Majors[10] moved into the online distribution space, but failed to establish viable business models. The second shakeout stage coincided with the launch of Apple's iTunes by 2006 and the launch of YouTube. The third wave, of consolidation, emerges from 2012, when a number of players such as Apple, Netflix, Amazon, Hulu, start consolidating their market positions in the VOD space.

VOD in Europe is also on the rise, although with different maturation levels across countries. The United Kingdom, 45% amounting to EUR 233 million, and the nordic countries (Sweden, Denmark, Finland and Norway), 28.4% and a total of EUR 148 million, make up almost three quarters of the overall European consumer spending on VOD services (IVF and IHS data cited in Grece et al. (2015)). European consumer expenditures on Internet VOD have significantly increased between 2009 and 2013, accounting in 2013 for about 60% of the total spending on video on demand, and reversing 2009's breakdown, in which pay-TV VOD represented about 77% of total spending in VOD. Figure 4.6 shows the breakdown of European consumer spending on VOD between 2009 and 2013 for TV VOD (VOD consumed as part of a pay-TV subscription over the STB or TV Everywhere service) and Internet VOD in its three dominant business models — subscription, electronic sell through (EST) or download to own, and download to rent. Consumer spending on subscription VOD in 2013 amounted to EUR 520.9 million, representing an increase of 147.5% compared to the preceding year.

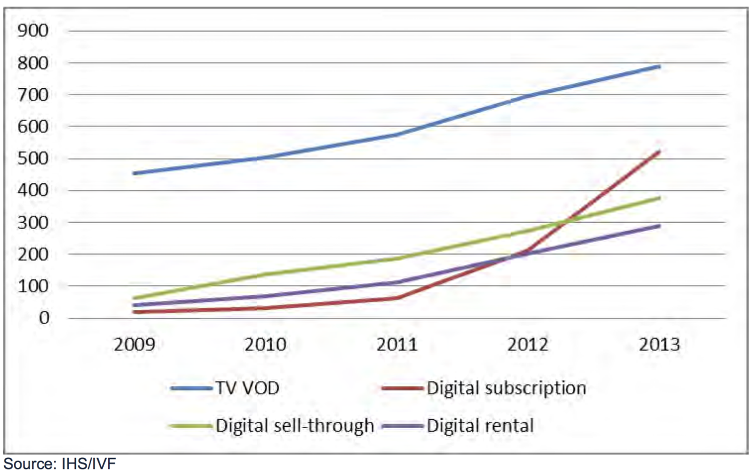


Figure 4.6: European consumer expenditures on VOD between 2009 and 2013 in EUR million (IHS/IVF data cited in (Grece et al., 2015)).

[10]The Hollywood Majors are the major media conglomerates that dominate the film production and distribution. The "Big Six" majors include Twentieth Century Fox, Paramount, Columbia, Universal, Warner Bros and Disney (Wasko, 2003).

The European market for Internet VOD is quite fragmented, with more than 500 active players, and each country's market maturing at different rates (Grece et al., 2015). In the last European Audiovisual Observatory's report, Grece et al. (2015) argue that the most mature european markets, like the Nordics and the United Kingdom, are also the ones which saw the entry of international players such as Netflix and, to a lesser extent, Amazon Instant Video. Netflix promises to reach 200 global markets by 2016, earlier than it previously expected (Bond, 2015), while iTunes (either EST or rental, or both models) is already present in almost every European country (Grece et al., 2015). In addition, Wuaki TV, a spanish player acquired in 2012 by Japan's e-commerce giant Rakuten, currently available in Spain (1.25 million subscribers), the U.K. (400 thousand subscribers) and Italy, France, and Germany, is planning to expand in 2015 to 15 European countries (Briel, 2015). A survey conducted by the European Audiovisual Observatory in 2014, revealed that the catalogues of half of the 74 VOD services surveyed included a proportion of European works inferior to 50% (Figure 4.7), while only 18 of the respondents identified a share of European content above 50% (Grece et al., 2015). Similarly, the analysis of the catalogues of seven European VOD services, showed a general higher proportion of non-European content (except for Maxdome service) (see Figure 4.8).

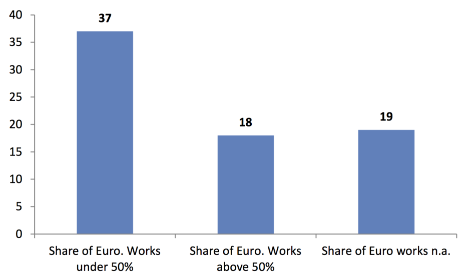


Figure 4.7: Number of European VOD services with a proportion of European works below and above 50% (Grece et al., 2015).

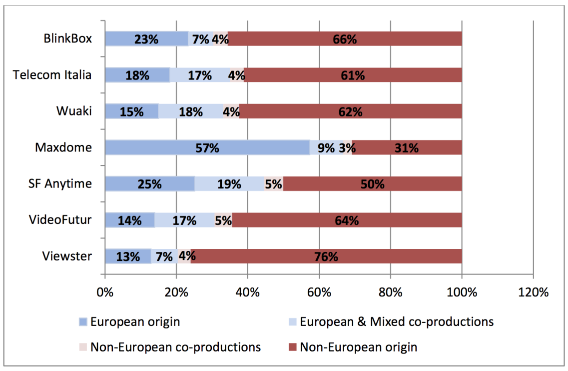


Figure 4.8: Percentage of total video works by origin for 7 European VOD services (Grece et al., 2015).

Broadcasters offers for watching linear content through the Internet, or to catch-up on missed content of the past days, are also becoming more popular. BBC's iPlayer, the VOD and catch-up platform for BBC's public broadcaster, was launched back in 2007 and was one of the first services to show the potential of catch-up TV. As Reed Hastings, Chief Executive of Netflix, contended:

"The iPlayer really blazed the trail. That was long before Netflix and really got people used to this idea of on-demand viewing." (Heath, 2015). Back in January 2015, iPlayer reached 264 million requests for TV content mostly from viewers using mobile devices, tablets and computers (see Figure 4.9). Viewership reaches highest numbers in evening and night hours between 6pm and 11pm, showing a very similar pattern to broadcast TV viewing.

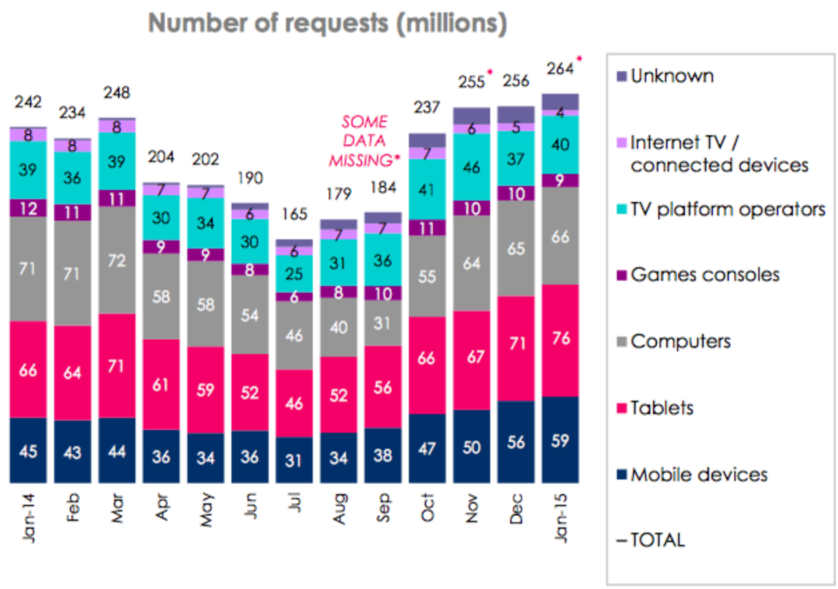


Figure 4.9: Requests for TV programmes on BBC iPlayer by device type (January 2014 - January 2015) (Andersson, 2015).

Also interesting to note the initiatives of premium channels, such as HBO and Canal+, which offer catch-up and on demand content for pay-TV subscribers, but also launched other offers outside the realm of pay-TV services, in order to reach directly the viewer. HBO makes available catch-up service HBO Go included as part of HBO subscriptions acquired through pay-TV operators, and has recently launched HBO Now, a standalone VOD service giving access to HBO content catalogue and Hollywood blockbusters on a monthly subscription base. Canal+ also offers myCANAL app for live and catch-up content for pay-TV subscribers, while CanalPlay was launched in 2011 as a standalone VOD service provided directly to consumers. CanalPlay offers a large variety of films, TV shows, and children programmes, competing, at least in catalogue size, with Netflix France (Lechevallier, 2014). Monthly subscription prices vary in terms of the type of devices the viewer intends to use to watch content — a higher priced subscription allows the viewer to watch content on TV using an STB, Apple TV or XBox.

The short sample of services and market data here presented was selected to provide an overview of the rise of and wide selection of services offering professional video content over the Internet, as well as highlight the fact that most of these services compete for the same audience with the same content.

4.3 Technology

Not only consumption trends are changing, but content management and delivery is also in transformation to allow the distribution of content over the Internet to a myriad of devices. Several interviewees pointed out two aspects which have disrupted their businesses. Firstly, for digital delivery, content needs to be in digital format. But many stakeholders (e.g. broadcasters), based on their core business, still hold great amounts of content in analogue formats and own equipment and legacy systems for producing and preparing analogue content. An additional step in the content preparation workflow is thus required: analogue content which is generated and stored in different systems (in some instances, audio and video are kept in different systems and are integrated in real-time for broadcast) needs to be ingested into a digital video platform. New players are typically all digitally based and do not face this challenge. Secondly, the requirements of online video services are considerably different from the TV world. There are several new factors to take into account: (1) support for multi-screen and multi-device, whether video is delivered via a Web browser or a specific app; (2) ensure content is protected, encrypted and meeting rights holders licencing models; (3) provide a friendly interface and personalised experience; (4) deliver a high perceived quality of experience and service; (5) define and enforce pricing and business model rules (e.g. content expires 24 hours after download).

As a consequence, the activities of the digital video production workflow have considerably changed when compared to analogue video production or even to digital video production as it was a decade ago, mainly due to the myriad of new technologies, devices and operating systems.

The activities of the current digital video workflow for online video services can be generally depicted as in Figure 4.10 (author's own contribution based on interviews material). Content from different sources, content creators, Hollywood studios, producers, is ingested into the video management platform, also known as Online Video Platform (OVP). In the encoding step, the raw video (typically in analogue format) is converted into a particular format suitable for storage and output, usually with no or little quality loss. It then goes through the transcoding step, in which it is converted into one or several compressed formats, suitable for streaming at different quality levels and resolutions. Multi-screen delivery to an increasing number of devices is intensifying transcoding requirements with several files in different formats being generated for the same video asset. Annotation, indexing and cataloguing are optional but important activities, allowing an online video service to offer better search and catalogue functionalities, such as content recommendations. In the encryption step, a Digital Rights Management (DRM) solution is applied for the secure exchange of encryption keys and the association of various rights with those keys (Rutz, 2014), reassuring rights holders that rights and licences are enforced, i.e. controlling usage by restricting redistribution, supported playback devices, download, copy and simultaneous playback. All the stages of the video workflow can be performed onsite at the provider's facilities, but are increasingly moving to OVP platforms available in the cloud. Cloud based platforms allow for cost savings, but also to achieve gains in efficiency, scalability and in streamlining operations.

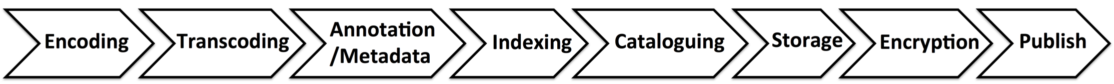


Figure 4.10: Digital video workflow.

Once the video asset is published it can be delivered over the Internet. Video assets or live streams will typically be delivered using a Content Delivery Network (CDN) ready to respond to multiple requests from a variety of users and devices. Certain CDNs also encrypt content (typically, live streams) just before content is distributed.

The technologies available to encode, transcode and protect content are strongly dependent on the type of devices to be supported and DRM technologies to be enforced. The following discussion provides a glimpse of the technological choices available for these tasks. This description does not intend to be exhaustive, but rather to show the wide scope of technological options, the fragmentation among the technologies adopted by leading consumer electronic devices, the lack of *de facto* standards, and what these aspects represent in costs and technological decisions for online video service providers, as highlighted by respondents.

During the transcoding step a given digital video input (e.g. originally in MPEG-2) is converted into another "friendly" format (e.g. H.264), meaning a format that is suitable for streaming and compatible with most types of Web players and devices. This is a necessary step given that each browser or video player only supports a specific subset of video formats. Each video format has its own set of encoder/decoder (or video codec), that allows for compression and decompression of digital video. Besides, not all computers, tablets, smartphones and STBs support the same set of video formats, which makes it necessary for a video to be encoded into a suitable format for each device. Mostly used formats for online delivery include H.264/MPEG-4 AVC (and its successor HEVC or H.265 and MPEG-H Part 2), WebM VP8 (and its successor VP9) and WMV. Compression technologies also incorporate different types of video resolution standards. The resolution of a video image refers to the number of pixels presented — images with higher pixel counts have higher resolution. In Internet video, many different video resolutions are used, ranging from Standard Video (SD) at 480 or 576 horizontal lines of pixels, High Definition (HD) at 720 or 1080 lines, to the latest Ultra HD 4K and 8K at 2160 and 4320 lines respectively. Currently, 4K is considered the future of digital entertainment, expected to make media more immersive. Online video content is starting to be available also in 4K, with Netflix, YouTube and Amazon already offering a selection of content in this resolution (Betters, 2014). But many consumer electronic devices have yet to support this new resolution standard.

In transcoding, video assets can also be converted into formats suitable for streaming in order to adjust the video file to the requirements of the device that will play it and consequently to improve the size, speed and video quality of the video content. Adaptive bitrate streaming (ABR) technologies transcode the source content into multiple bit rate streams. ABR replaces earlier protocols such as the real-time transport protocol (RTP) and the real-time streaming protocol (RTSP). While delivering content, adaptive bitrate streaming technologies detect the user's bandwidth throughput and CPU performance in real time and send the suitable stream according to the user's resources via HTTP (suitable for Web delivery). ABR practically eliminates buffering and dynamically adjusts the video stream's bit rates as network conditions and destination devices change throughout the viewing experience, resulting in a fast start once the user clicks play and a good quality experience even for slow network connections. Moreover, ABR is compatible with existing Internet infrastructure, streams are able to traverse firewalls and home networks like standard Web traffic, and allows for uninterrupted delivery of video over variable network conditions (Motorola, 2012).

There are several implementations of ABR, but not all CE devices support all of them. The most used ABR implementations are:

- HTTP Live Streaming (HLS): implemented by Apple, is mainly supported on Apple devices and limited on Android devices;
- Smooth Streaming: introduced by Microsoft, is supported by many different vendor devices. However it is the only protocol supported in Xbox and Windows smartphones;
- HTTP Dynamic Streaming (HDS): implemented by Adobe is supported in Flash players and across Windows, OS X and Linux;
- Dynamic Adaptive Streaming over HTTP (MPEG-DASH): was developed by MPEG[11] as an international industry standard and deemed to replace the proprietary standards presented above for wide device support (although currently not supported on Apple iOS devices). It is also backed up by an industry group, DASH Industry Forum[12], which includes firms such as Adobe, Microsoft, Google, Netflix, Samsung, Sony, and many OVP providers. As it was published as a standard in 2012, the market still has to take it up, in particular CE vendors, OVP providers and online video service providers. Netflix, YouTube and Hulu already adopted MPEG-DASH (Weil, 2014).

DRM technologies are at the moment quite fragmented among operating systems and supported devices. Developing a service aiming at multi-device/multi-operating system while meeting rights holder requirements, ends up being a cumbersome task. While there are several competing DRM solutions, currently, there is not a single DRM solution that covers the whole range of devices and operating systems. The most widely supported DRM solutions (Weil, 2012; Encoding.com, 2014; Ruan, 2014) for online video rights protection are:

1. Widevine: recently acquired by Google, supports a wide range of TVs, STBs, iOS and Android devices, as well as Mac OS X, Linux and Microsoft Windows;

[11] Moving Picture Experts Group (MPEG) is a working group dedicated to the development of audio and video compression and transmission standards formed by ISO and IEC.
[12] Full list of members available at http://dashif.org/members/

2. Microsoft PlayReady: supports a number of TVs, STBs, iOS, Android, Mac OS X, Microsoft Windows, along with Android TV[13], Xbox and Windows Mobile;

3. Apple FairPlay: is a built-in component of the QuickTime software, which is installed on all lines of Apple devices;

4. Adobe Primetime: does not support TVs and STBs, but given that most Web embedded videos play with Adobe Flash, Primetime is widely adopted to protect content in Web browsers in smartphones, tablets and computers with iOS, Android, Mac OS X, Linux and Microsoft Windows;

5. Marlin: created by an open-standards industry community initiative called the Marlin Developer Community[14] composed by Intertrust, and four CE vendors, Panasonic, Philips, Samsung and Sony. Supports a wide range of TVs as well as iOS, Android, Mac OS X, Linux and Microsoft Windows.

Since no single DRM solution covers all the devices available in the market, when choosing a particular solution targeting specific devices, one needs to check if it is interoperable with the streaming technology to be used and if it meets rights holders' requirements. Finding the right combination of streaming and DRM technology to deliver video content to a multitude of devices with a satisfactory end-user experience is an important step for online video service providers. Thus, this activity often relies in using several third-party tools provided by media processing service providers or to migrate to an OVP in the cloud, which integrates the whole workflow and provides support for multiple encoders, transcoders and DRM solutions.

[13] Google TV was a smart TV platform developed by Google, Intel, Sony and Logitech, integrating Google's Chrome browser, YouTube and Google Play. It was available as a software platform pre-installed on Sony and LG's smart TVs and as a standalone digital media player to be connected to a TV-set. Google TV was succeeded in June 2014 by Android TV, which can also be embedded in digital media players and smart TVs. The revamped software platform was launched with the promises to deliver a unified platform with a better user interface and a content recommendation system aiming to look like an entertainment hub such as Apple TV or Roku (Wallenstein, 2015). In 2015, Sony, Sharp and Philips have announced Ultra HD and 4K smart TVs with Android TV built-in for the European and U.S. markets (Larsen, 2015b,c,a). In addition, together with Asus, Google released a digital media player, Google Nexus Player, with Android TV built-in to compete with Apple TV.

[14] Website at http://www.marlin-community.com

4.4 Value Network

The value network discussed in Subsection 4.4.2 is the result of an iterative process of feedback obtained in expert interviews. The initial value network was very much inspired in traditional value chains described in literature (a short review is given in subsection 4.4.1) and has evolved through a cycle of feedback and updates. All experts related with the industry were asked to comment on the completeness of the value network and to identify aspects related with business roles and relationships which were not accurate and could be improved. Although certain areas of the value network could be further developed (for example, in which concerns advertising and customer analytics activities), the derived value network extends significantly what has been described so far in literature. Specifically, it encompasses a larger scope by bringing together in one single diagram the value add activities related not only with content production and distribution, but also with service, application and device development functions[15].

4.4.1 The Traditional Value Chain

Literature in media and strategic management embraces the concept of value chains to assess the role of innovation for media firms. Conceptualisations may highlight different stages/activities in media services. For instance, Doyle (2013) deconstructs media industries' vertical supply chain in three broad stages (production, packaging and distribution), highlighting the interdependencies between all stages and the implications for firms' performance if a bottleneck arises in the supply chain (i.e. monopolisation of one stage). Chan-Olmsted (2006a) considers a media production value chain comprising acquiring and creating content; selecting, organising, packaging, and processing content; and producing, manufacturing, and transforming content into distributable form. Wirtz (2011, p. 62) portrays a fairly complete generic value chain of the media industry (Figure 4.11), based on previous work which established five value added stages activities in the multimedia value chain: content/service creation, content/service aggregation, value added services, access/connecting, and the navigation/interfacing stage (Wirtz, 1999). The new value chain for markets creating and selling digital media content over the Internet is composed of five stages:

[15]In fact, the derived value network was considered by one respondent as the most complete representation of the business of online video services he had so far observed

procurement of online content, creation of online content, packaging of content and services, technical production, and distribution (Wirtz, 2011).

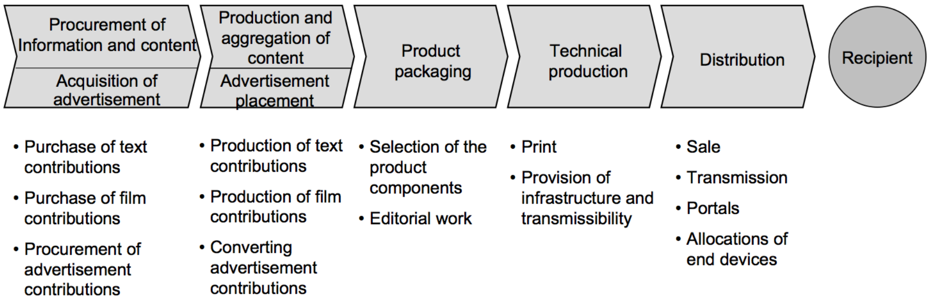


Figure 4.11: Value chain for digital media distribution over the Internet (Wirtz, 2011).

Picard (2002) explores the evolution and future prospects of ICT industry convergence-based business models for online content service providers and focuses in the distribution value chain and underlines marketing, advertising, promoting, and distributing activities. While analysing the digital transformations affecting television processes, Rangone and Turconi (2003) divide the TV value chain into four main stages: content and service production, content and service provision, network provision, and access terminal provision. Similarly, Chan-Olmsted and Kang (2003) use the value chain established by Wirtz (1999) to analyse the emerging broadband television industry. Recent work by Gimpel (2015) focuses on the video entertainment sector and key questions shaping the future of video platforms. Gimpel considers a business ecosystem comprised of the following main actors: internal and external content provider, advertiser, broadcast network, OTT video platform, communications firm, and consumer/viewer.

4.4.2 Current State

The generic value network derived in this study follows the technique described in section 3.5 and is deemed to represent the current market state for online video services. The main business roles associated with online video services are summarised in Table 4.2 and the service and financial flows between roles are detailed in Figure 4.12.

The business roles in the value network have been grouped into five value streams: Content, Distribution, Application, Device and Consumption. The business roles and actors to be discussed cross several industries — film, TV, telecommunications, Internet, IT and consumer electronics —

Table 4.2: Main business roles associated with online video services provisioning.

Business Role	Description
Content creation	Screenwriters and filmmakers develop ideas for original content.
Content development	The production and development of original content.
Content processing	The encoding of content into a digital format and transcoding for delivery over the Internet, typically with streaming technology.
Content encryption	The application of DRM technology allowing rights holders to set and enforce terms by which people can use and distribute content online.
Content aggregation	Bundling of internally produced or externally acquired content from multiple producers and rights holders under a brand or platform.
DRM license issuing	The provision of DRM licenses to protect content according to the usage rules specified by the rights holder.
DRM technology provision	The provision of DRM technology to protect content and encapsulates the necessary mechanisms to support diverse business models for delivering content (subscription, pay per view, download and ad-based).
Online video provisioning	The provision of a (live or video on demand) video service over the Internet (unmanaged network) through streaming.
Rights management	Bundling of content rights to different content distributors for diverse mediums.
Ad brokerage	Bundling of several advertising campaigns to be distributed among online video services.
Advertising	The allocation of budget for advertising campaigns.
Broadband access provision	The provision of Internet broadband access, fixed or mobile, to consumers.
Internet network management	The provision of connectivity to the Internet through the management of heterogeneous networks over which IP traffic is routed. Transit and peering agreements are made amongst providers.
Content storage	Storage of video content in cloud computing servers.
Content caching	Storage of popular video content on servers closer to the consumer for distribution.
Application development	The development of an application which allows consumers to search, select and consume video content.
Application cross-device integration	Integration of software modules which allow the application to run on different end-user devices.
Application DRM support	The support of modules which validate the DRM license for the specific content to be played.
Application provision	The provision of a software application through an app store or natively embedded on a device.
CE device development	Development of the hardware components of the device.
CE device DRM support	The support of modules which allow DRM technology on the device.
CE device OS development	The development of the operating system which allows the device to operate.
CE device service provision	Selling the device and support to the consumer.
CE device purchase	The acquisition of a device to be used by the end-user for content consumption.
Audience data collection	Audience data is typically collected at device or operating system level.
Audience data management	Audience data once passed on to the application level is typically managed by the service provider.
Video consumption	The acquisition and consumption of content through an online video service by the end-user.
Application consumption	Acquisition of an application that allows the consumption of the online video service.
Broadband consumption	The consumption of a broadband service by the consumer.

even though, as will be addressed in the following chapter, the borders of these silos are becoming more and more blurred. The very first activity constitutes having an idea for new content and developing it into a script to be later produced as film or TV content. Generally, content authors (creatives, screenwriters and filmmakers) are involved in the creation, and content producers in developing the format of the content (creation, planning, supervision and realisation of the format).

Rights management concerns defining, bundling and managing content rights for diverse physical and digital supports. Examples of actors include rights holders and rights dealers, who share licences' revenues with content producers. Content processing and encryption involve several technological tasks, as described previously in the digital video workflow presented in Figure 4.10,

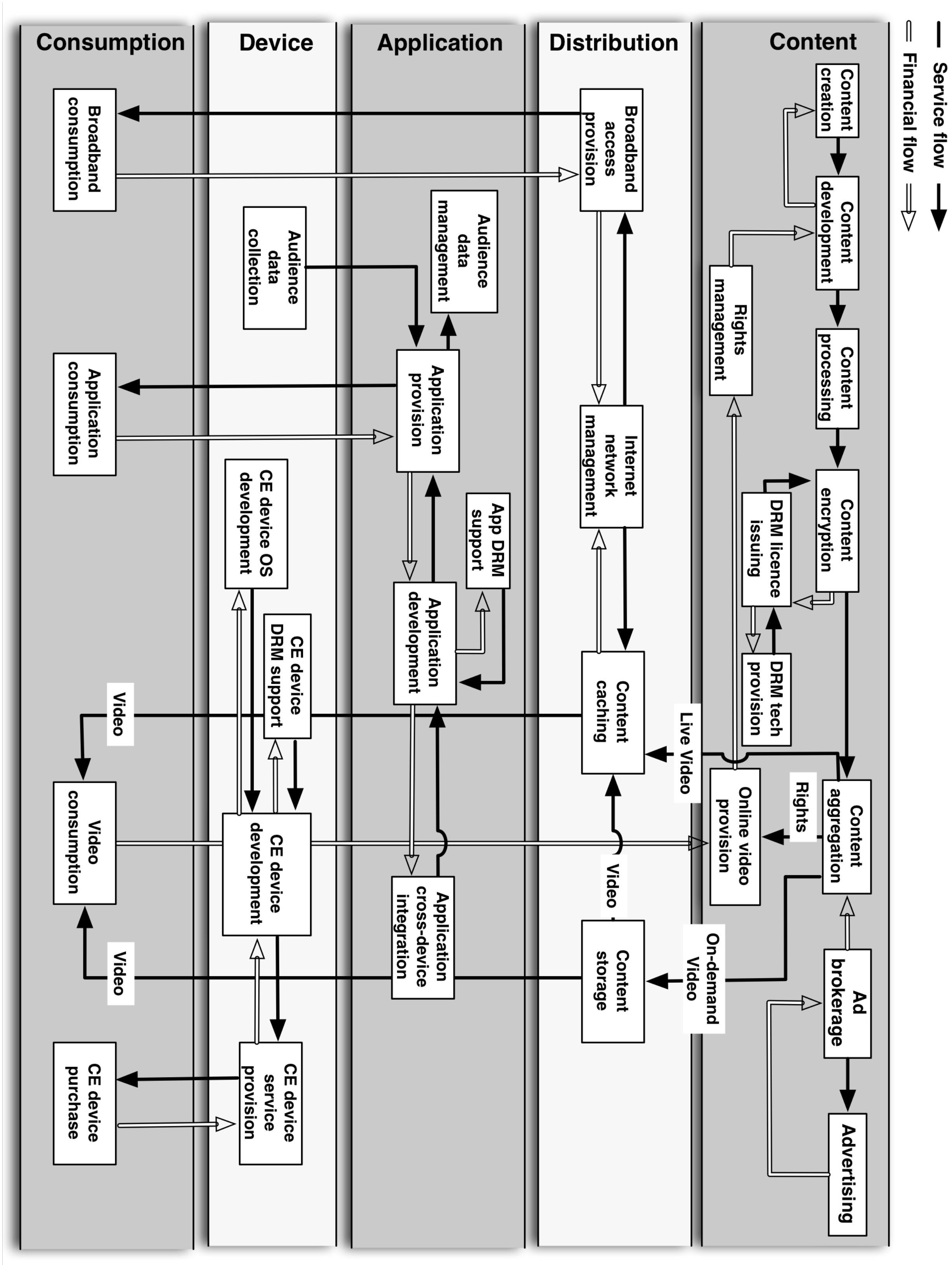


Figure 4.12: Generic value network for online video services.

to transform content in digital format and the use of tools to restrict the unlawful distribution of copyrighted content and enforce terms by which viewers can watch content online. Often these tasks are executed in an Online Video Platform, a software which allows performing all the steps of the digital video workflow, or in several, often legacy, software applications. As described in Section 4.3, for DRM protection a technology needs to be chosen depending on the streaming technology and end-user device the service will be available on, and respective licences need to be acquired to protect content. Online video service providers bundle digital content acquired from multiple producers and rights holders under a brand or platform and stream that content either on demand or linearly, ensuring that content rights are respected. In the aggregation phase, content can be bundled with advertisements produced and promoted by advertising agencies, and then distributed by advertisement brokers, which share revenue with online video service providers. Thus, online video service providers manage the relationships with the audience (their customer base), with rights holders for content procurement, and with ad brokers, for delivering ads in the various platforms and formats.

Video assets for on demand streaming are often stored in a cloud computing service or within in-house servers. To provide a better service for the viewer, in the distribution stream, online video service providers are choosing to cache popular video content (video assets or live streams) using the facilities of content delivery network providers. CDN providers cache content in a distributed manner in servers hosted in networks and data centres around the world serving regions with high content requests. Normally, each video asset in its multiple output formats (i.e. multiple files of the same video) is cached to respond to a multitude of end user devices. CDN providers usually do not own network infrastructure but rather rely on eyeball ISPs[16] to host their servers and to distribute content to end users. Content is routed over the Internet through peering and transit[17] agreements amongst Internet Exchange Points[18] (IXP), transit operators[19] and eyeball ISPs.

[16]Eyeball ISPs provide Internet access to residential and business customers, i.e. support the last-mile connectivity through high investments on infrastructure (Ma et al., 2010). Often, eyeball ISPs also provide other services (TV, phone, etc.) bundled with Internet access.

[17]The distinction between these two agreements is not always clear. Peering is the business relationship whereby ISPs reciprocally carry each other's traffic. Usually, ISPs of the same size peer with each other, i.e. carry traffic of each other and their respective customers in order to reduce latency. On the other hand, transit is the business relationship whereby one ISP pays another to carry traffic, i.e. to have access to the other ISP's routing table destinations (Candeub and McCartney, 2009; Norton, 2001). Peering is usually free, while transit may imply a payment.

[18]An Internet Exchange Point facilitates the physical interconnection of the networks of multiple ISPs, i.e. facilitates public and private peering between ISPs (DrPeering, 2014).

[19]Transit or backbone ISPs with a large geographical footprint provide transit services for other ISPs and do not purchase transit from anyone (Ma et al., 2010), e.g. tier-1 ISPs such as Level 3 or Cogent.

On the user side, content is streamed on the online video service provider's website (Web app), or via an app (for computers, tablets and smartphones, often available on appstores) or via widgets (for media players, STBs, connected TVs, etc.). Depending on the service's business model, content can also be offered for download, allowing viewers to watch the content at a later time with no access to an Internet connection. In this case, normally content still needs to be played with a specific application provided by the service provider. Application development involves conceptualising and developing these apps and widgets for different operating systems and CE devices. In order to build software that runs on multiple operating systems and devices, a number of cross-platform programming toolkits may be used to facilitate this task. Applications should also encapsulate the chosen DRM technology so that a DRM licence issued for a video can be validated ensuring content can be played according to the settings defined for that video, e.g. if the viewer rented a film for 48 hours, the DRM licence ensures that the video "expires" after that elapsed time after the first playback. Development and provision of consumer electronic devices (e.g. smartphones, tablets, etc.) also includes the respective modules for the operating system and DRM technology. Typically, a CE vendor develops and provides devices to consumers and pays licence fees to an OS vendor and to DRM providers for encapsulating those software modules. Audience data collection can take place at CE or OS level and can then be accessed for management at application level by the online video service provider.

To acquire video content a viewer is required to own a CE device connected to the Internet (a broadband subscription may be required), which runs a Web browser or specific app/widget giving access to search and find capabilities, which ultimately will allow the user to play the selected video content. Depending if the video content is streamed or has been previously downloaded, an Internet connection may not be needed during playtime.

Although not represented in Figure 4.12, there are also regulatory functions which can be applied to any of the four streams which may limit or strengthen the creation of value and determine the limits of control and power in control points. Regulatory functions are not limited to formal governmental regulatory actors, but other institutions which may also shape regulatory outputs, such as consumer or industry group associations, are also included.

Finally, one or more business roles here explained can be grouped into added-value activities under a single actor, depending on control points and chosen business models.

It is worth underlining that the actor ‘online video service provider’ was employed in the previous description to refer to a generic actor that provides an online video service. However, as already unveiled in Section 4.2, online video services are provided by ‘old’ and ‘new’ players of the media industry as follows:

- Broadcasters, commercial or public, premium and free-to-air, which redistribute content to a mass audience, but might as well be content producers themselves;
- Pay-TV operators, which package TV channels in one or several types of subscriptions served to the consumer. Pay-TV operators (cable, satellite, IPTV) normally pay retransmission fees to broadcasters and can be telecom operators and ISPs as well;
- Rights holders, which hold the rights for content distribution and share licences’ revenues with content producers. In some cases, can also be involved in directly financing content production;
- Content Producers and Distributors, which produce content, mostly films, and alone or in association are paving their way for a direct customer relationship through online video services;
- Consumer electronics (CE) vendors, which sell devices (e.g. smart TVs, consoles, set-top boxes, smartphones, tablets, personal computers) that allow consumers to get access to online video services;
- Internet players, which established their initially activity in IT or in the Internet realms and have grown into giant players with services and hardware in various sectors;
- Online video aggregators, are new players in the media and Internet industries, which offer video content by means of the Internet and establish their activity through a platform aggregating and repackaging content from content producers and broadcasters.

4.5 Revenue Models

There are broadly five prevalent types of revenue models supporting online video services: subscription, download to own, download to rent, hardware acquisition, and advertising.

As explained by one interviewee, VOD revenue models can be instantiated in several ways. Subscription VOD (SVOD) allows access to a catalogue of content for a monthly or yearly subscription. In transactional VOD (TVOD) the viewer pays for each individual video to be watched. TVOD evolved into two distinct models: electronic sell through (EST), also known as download to own (DTO), requires a one time payment to own a video and watch anytime and as many times as wanted; digital rental, also known as download to rent (DTR), requires a one time payment to rent a video and watch within a limited period of time. These two TVOD models are akin to, respectively, buying and renting a DVD or a Blu-ray disk. In advertisement supported VOD (AVOD) viewers are allowed to watch content for free, however they must watch advertisements at various points throughout the video. In some services there are also upgrade plans that offer additional features such as ad removal, access to full-length content, access to content in high-definition quality, unlimited viewing of content, and access to a bigger catalogue.

Most VOD services offer a full catalogue of films and TV series on demand and are available on a national basis. Even for services that operate globally (e.g. Netflix, Amazon Instant Video, iTunes) catalogues differ from country to country due to licencing rights. Some services have developed specific business models around VOD. For instance, Universciné[20] (France) and Filmin (Spain) offer mainly European independent film productions, while MUBI releases a new film per day to be watched in the next 30 days, i.e. each day the catalogue comprises 30 films. CanalPlay offered by premium cable TV channel Canal+ is considered the biggest competitor of Netflix in France (Lechevallier, 2014). It offers a wide catalogue of films and TV series on a wide range of mobile devices, but requires a branded STB to stream content to the TV-set. Amazon Instant Video uses a transactional model (buy and rent), while Amazon Prime Instant Video is packaged with one-day delivery shipping for Amazon shopping and offers a wide catalogue of content on a yearly-subscription basis.

Within the large range of VOD services there are examples of services operated by rights

[20] Universciné was launched in 2001 by a group of French producers and distributors of independent films. The alliance counts today with 43 firms. Filmin was launched in 2008 by a group of Spanish producers, exhibitors and distributing firms and a technology firm. Both Universciné and Filmin are part of EuroVoD, a network of independent European VOD services specialising in art-house films and independent cinema. The main goals of EuroVoD are to support the network of firms with resources, exchange know-how to increase the transnational circulation of European films, promote cultural diversity, and to support VOD as a legal distribution channel of European films. Other members of EuroVoD include Universciné Belgium, Flimmit (Austria), Volta (Ireland), LeKino (Switzerland) and Netcinema (Bulgaria). This year, EuroVoD members started a process of convergence of user interfaces (web and mobile) into a single one, based on the same technologies and similar look and feel for all members.

holders (e.g. Hulu, Crackle, Disney Movies Anywhere), Internet players (e.g. Google, Amazon, Yahoo, Apple), broadcasters (e.g. HBO Now, CanalPlay, CBS All Access), pay-TV operators (e.g. TalkTalk's Blinkbox, Comcast's Streampix) and online video service providers (e.g. Netflix, MUBI, Wuaki.tv).

TV Everywhere services offer mobile access to linear TV as part of the pay-TV subscription the viewer already acquired. Most of these services also allow catching up with previously aired shows and offer a catalogue of films and series on a pay-per-view basis. Many of these services (e.g. Yelo TV, MEO Go) only work within the subscriber's home network or within networks of the pay-TV provider (e.g. public WiFi networks of the pay-TV operator). While other services lessen network access restrictions (e.g. Vodafone TV, TWC TV, Sky Go), some services remove restrictions for an additional monthly subscription (e.g. MEO Go Multi).

Live and catch-up linear TV streaming platforms are mainly offered on a subscription and ad-supported basis and allow viewers to watch live linear TV or to catch up with previously aired content. BBC's iPlayer actually has no ads for UK residents since it is supported by the UK television licence fee, but its international version is supported by ads or a subscription fee. France24 and RTP's Play, as operated by public-funded broadcasters, are both only supported by ads. Premium channels' linear and catch-up platforms (e.g. HBO Go, Canal+ myCANAL) are delivered for free for the viewers who already subscribe to the corresponding channels via a pay-TV operator.

Recent services launched by Sky and Dish Network, Sky Now TV and Sling TV respectively, give access to a package of linear TV channels on a live and catch-up basis for a monthly subscription. They fit under linear TV streaming platforms, although they are a sort of a pay-TV subscription which is delivered over the unmanaged Internet, rather than over a managed cable, IPTV or satellite network. The consumer pays for a subscription and may access a selected package of linear content on any mobile device and TV-set (Sky Now TV still requires an STB to stream to the TV-set).

Furthermore, Sony's PlayStation Vue is the most recent competitor to a pay-TV package in the U.S.. It offers live linear TV (about 50 channels) and catch up, as well as on demand content, for a monthly subscription, but can only be accessed through a PlayStation game console. So video consumption is tight not only to a recurrent subscription but also to a one-time hardware acquisition.

Sony already announced it would soon support Apple devices (Abbruzzese, 2015).

Figure 4.13 summarises and offers a view of the main actors involved in the direct provision of online video services to consumers. It should be noted that content available on these online video services is restricted to the rights cleared to that country (i.e. geoblocking) and to the media support/device (e.g. while a broadcaster/pay-TV operator may have the rights to transmit a certain TV series on broadcast/linear TV, it may not have acquired the rights to distribute that content online for a smartphone or tablet).

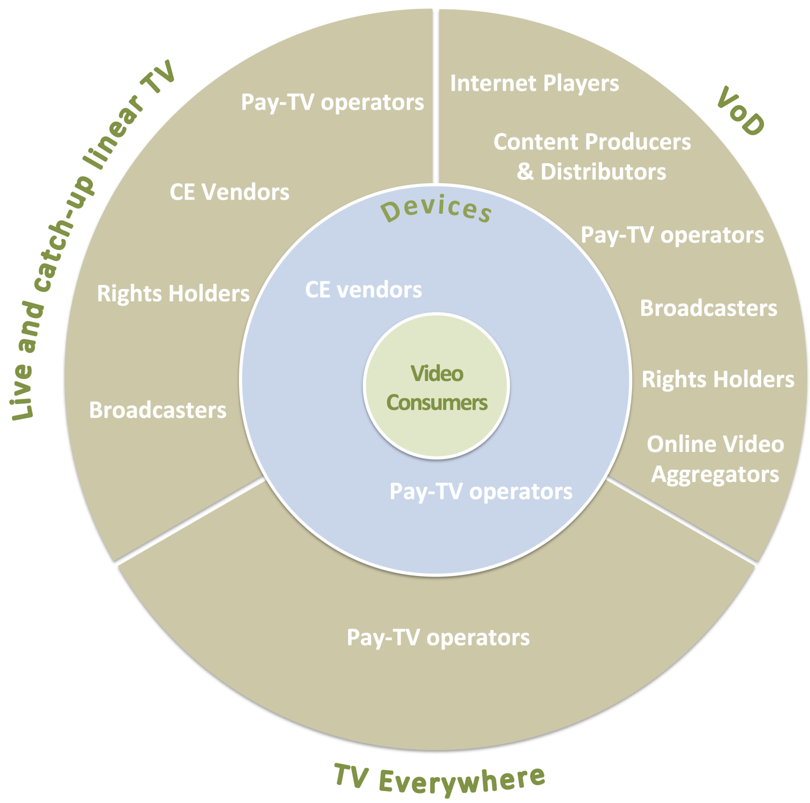


Figure 4.13: Types of online video services and main actors providing those services.

4.6 Business Strategies

This section presents a number of U.S. and European cases that illustrate how firms are responding to changes taking place around online video services. This analysis focuses on strategies employed to achieve or maintain a gatekeeper position and build up or maintain market power, based on the topology of strategic alliances previously presented in Section 2.4.1 – Table 2.3. Although the dividing line between competitors and non-competitors can be rather thin in the online video market, the first group addresses existing competitors, new entrants, substitute producers (indirect competitors) and potential competitors, while the second group includes customers, suppliers, as well as potential customers and suppliers.

In summary, in the following discussion it is suggested that traditional media gatekeepers typically engage in strategic alliances and mergers and acquisitions to establish new services and build a stronger power and bargaining position towards upstream and downstream players. Moreover, most actors involved in online video services provision are building strategic alliances with CE vendors to quickly enter a new distribution outlet, benefit from network externalities and build market power.

4.6.1 Competitive Alliances

Competitive alliances can take the form of agreements, joint ventures and horizontal concentration.

An example of agreements between competitors takes place amongst Internet players. Apple, Google and Amazon all compete in VOD platforms (respectively, iTunes Store, Google Play Store and Amazon Instant Video) for buying and renting movies and TV shows. These giant players also compete in the media player devices segment with Apple TV, Google Nexus Player and Amazon Fire TV, allowing users to watch VOD content on their TV sets. Obviously, all these media players can play digital content from their respective VOD platforms. However, for instance, Apple reportedly blocked at some point other VOD platforms, like Hulu and Amazon, from being available on Apple TV (Panzarino, 2012), thus creating a control point between these players and limiting consumer choice. Notwithstanding, over the past years, these players have increasingly partnered and have been adding support to other competing VOD platforms on their media players. The rule of thumb seems to be to intensify the value of the platform: the more content is available, the more valuable the platform is and more devices are sold. For instance, Apple TV supports competitors Netflix, Hulu Plus and Crackle; Nexus Player supports Netflix and Amazon Instant Video; Amazon Fire TV supports Netflix, Hulu Plus and Crackle. In Apple TV's case, it is said that Apple keeps 15 percent of each Hulu Plus or Netflix monthly subscription for each new registration that takes place through the device (via an iTunes account) and keeps customer and billing information (Kafka, 2015; Panzarino, 2012). All in all, by opening devices to other VOD competitors seems to allow

Apple, Google and Amazon to develop a compelling product, increase their revenues through increased devices' sales, explore economies of scale and hold a direct customer relationship, while locking-in consumers in their walled garden and building up a gatekeeper position (see Ballon and Walravens (2008) for similar gatekeeper positions held by Apple and Google in the past). For online video service providers, as these devices get more popular, it becomes increasingly important to target these additional distribution outlets and benefit from network externalities.

As for joint ventures between competitors, Hulu is a good representative case of such strategy. The Hulu venture was established in 2007 by NBC and FOX, and later joined by Disney (ABC) and Providence Equity Partners. As Comcast inherited a 32 percent stake in Hulu when the cable operator purchased control of NBC-Universal in 2011, NBC agreed to become a silent partner in Hulu's operations for seven years, as part of the federal approval of the merger. In 2012, Providence sold its 10 per cent stake in Hulu. Hulu's ownership structure has become complex, with three TV networks financially controlling the company, but with only FOX and Disney in operational control. It is remarkable that three close rivals have cooperated in establishing an online video platform, and that their venture got even stronger in 2012. By then, the Hulu venture was put for sale but despite bids from interested parties including Google, Amazon, Yahoo, DirecTV and AT&T, all three shareholders decided to call off the auction and invested an extra $750 million in upgrading the platform to compete against other online content aggregators like Netflix and Amazon. This example shows that competitors have chosen to act together, rather than separately, to fight for their market position and strengthen their content gatekeeper position against other online video services.

The case of LoveFilm, a UK-based DVD rental launched in 2002, is an interesting example of horizontal concentration. Similar to the early days of Netflix, LoveFilm grown over the years by acquiring competing online DVD rental platforms and eventually merged in 2006 with competing service Screenselect, under the LoveFilm brand. In 2008, LoveFilm acquired Amazon's DVD rental business in Germany and the UK, and in return Amazon became the largest shareholder of LoveFilm. In 2009, LoveFilm also expanded into Video on Demand and became the leading online DVD rental and streaming outlet in the UK. In 2011, Amazon, which already owned 32% of LoveFilm, announced it would take full control of the company in an acquisition deal of £200m. The deal happened just after Netflix announced its intention to expand to Europe and was thought as Amazon's anticipated move to take a foot on the European market. Complementarily to the U.S. based Amazon Instant Video, Amazon kept the brand LoveFilm in Europe until February 2014, when it announced the brand would be folded into Amazon Instant Video as well. With LoveFilm's acquisition, Amazon leveraged on LoveFilm's strong brand and significant customer base in order to smoothen its entrance and strengthen its position in the UK market.

4.6.2 Collaborative Ventures

As previously identified, collaborative ventures can be realised as agreements, joint ventures, upstream and downstream vertical integration as well as diversification.

VOD service Netflix is the leading player of several agreements. Netflix has partnered with a number of pay-TV operators to enable access to Netflix through the STBs distributed by the latter. In 2013, Netflix announced an agreement to incorporate the Netflix app on UK's Virgin Media clients' STBs. In the beginning of 2014, a similar deal was also announced with Swedish pay-TV operator ComHem. Both pay-TV operators' press releases endorsed these agreements underlining the added value of Netflix's addition to their STBs, by complementing and strengthening their pay-TV offers. But in practice, such agreements actually allow Netflix to quickly enter a new market (Netflix launched in UK and Sweden in 2012) and build on the pay-TV operator's customer base, in order to compete with well established players.

A different outcome can be observed in Netflix's deals with ISPs, such as with Comcast and Verizon. Netflix agreed to pay Comcast and Verizon for faster and more reliable access to the ISPs' networks, acknowledging well known control points owned by ISPs in terms of network connectivity and content distribution. These agreements demonstrate the growing power of ISPs and how they have been able to leverage their gatekeeping position to players which depend on their infrastructure. But only the wealthier players will be able to pay for such deals and compete in this environment. In addition, these ISPs are likely to get more subscribers, the ones that value Netflix above all, and lock them in. These deals have also sparked discussions on how Netflix traffic gets a preferential treatment and how such agreements threaten net neutrality rules.

YouView provides an example for joint ventures between non-competitors. YouView is a UK connected TV service offering access to terrestrial channels via Freeview (DTT) and Internet-delivered TV services (e.g. BBC iPlayer) via a hybrid set-top box connected with a broadband connection and/or television antenna. YouView is a joint venture created in 2010 with seven equal partners, including broadcasters (BBC, ITV, Channel 4, Channel 5), broadband providers (BT, TalkTalk) and DTT network infrastructure provider Arqiva – all partners financially committed to invest a total £126 million in the venture to cover the first four years of operation. Though they are all equal shareholders, BT and TalkTalk also use YouView to power their own pay-TV offerings and expand their control points as part of their subscription packages. However, YouView aims to maintain the relevance of free-to-air television (via Freeview) without gatekeeping, therefore there is neither subscription nor contract for accessing catch-up and Freeview content.

Upstream vertical integration involves a downstream firm acquiring an upstream firm, in order to secure important resources, such as content, and weaken competitors by reducing their supply. The acquisition of NBC-Universal by Comcast illustrates this case. By acquiring NBC-Universal, Comcast turned into a vertically integrated cable operator. However, concerns grew about the merger's potential anticompetitive effects as it would enable Comcast to restrict access to NBC programming available on Hulu and instead disfavour competing online video services to protect its own TV Everywhere service Xfinity. As the U.S. government was concerned that Comcast would try to impose restrictions on Hulu to protect its core cable business, it barred Comcast from being involved in Hulu's business affairs.

On the other hand, in downstream vertical integration, an upstream player acquires a downstream player in order to guarantee an outlet for its content and become a competitor in a new segment. In 2013, RTL Netherlands has bought Dutch VOD service Videoland in order to serve its content in the VOD platform but also as an effort to compete with the arrival of Netflix to the Dutch market. RTL acquired 65% of the shares of Videoland's parent company The Entertainment Group (TEG) to become the largest provider of online movie content in the Benelux region. RTL said it would use the Videoland service to help launch a subscription-based service, which would give users unlimited access to international and Dutch movies and series for a fixed monthly fee (Briel, 2013). This acquisition contributed to position RTL in the VOD segment, build up market position against Netflix, and led to a full ownership of Videoland in April 2015.

In diversification strategies, a firm enters a different business, which is somehow related with its current business. Blinkbox is a UK VOD service launched in October 2007 with the backing of a number of venture capital firms. In 2011, UK's largest supermarket chain Tesco, acquired an 80% stake of Blinkbox from private equity investors Eden Ventures and Nordic Venture Partners. Initially, Blinkbox had both an advertising and a pay-per-view business models. Later, after Tesco's acquisition, Blinkbox adopted pay-to-download and pay-to-rent models and a new ad-based supported service (ClubcardTV) was created exclusively for Tesco's loyalty card members. An earlier incursion of Tesco into the media sector, has lead it to create an online DVD rental service. But, with Blinkbox's acquisition, Tesco has started to use this brand as a catch-all digital entertainment brand, launching ClubcardTV, Blinkbox music (music streaming service) and Blinkbox books (ebooks online shop), and has been able to position itself in several media segments. Allegedly, Tesco's expansion into entertainment did not work so well, despite the big and strong catalogue, it did not attract many new customers. Due to an ineffective marketing strategy or for being Tesco's non-core business, Blinkbox VOD ended up being sold to pay-TV and telecom operator TalkTalk in January 2015, Blinkbox Music was sold to online streaming platform Guvera, and Blinkbox Books was shut down.

This section discussed two types of strategies online video stakeholders have been fiercely involved in. The examples presented illustrate stakeholders' strategies to strengthen their market position, enlarging their customer base, securing crucial resources (e.g. content, infrastructure), locking in consumers, in order to become a player in a new segment, compete with established players, weaken competitors or to face the entrance of new competitors.

4.7 Conclusion

This chapter provided a broad perspective of the current state of online video services, going beyond the so-called over-the-top video, to serve as background understanding for the interview analysis that follows. This overview considered a wide range of services delivering video over the Internet offered by not only online video aggregators, the new entrants in the sector, but also by the "old" actors of the media, ICT and telecommunications sectors.

Having seen the transformations in digital media consumption (anytime, anywhere on any device) and the penetration of new players, notably Netflix, the old players are trying to get a portion of the potential market, by reinventing their market positions and pursuing direct customer relations.

The old players perceive the new players as directly or indirectly benefiting from resources they do not own nor contributed to finance new content or infrastructure.

Having said that, the diversity of online video services reflects these perceptions and positions, with several actors exploring new avenues to monetise resources, reach scale, establish a direct customer relationship, and in some cases, launching new services, as 'lighter' and cheaper versions of existing services, in order to retain customer base. Therefore, the three types of services analysed — VOD, live linear TV, and TV Everywhere — rely mostly on the same professional content and compete for the same type of audience, with different revenue models but with little price and feature differentiation. Even though some services with an international scope are attempting to consolidate in one or more countries and expand to new markets, it can also be argued that, taken together, services are still at an exploratory stage and present a low level of maturity.

Table 4.3 presents a taxonomy for online video services. Services highlighted in the taxonomy are used as examples and are the ones which have been mentioned throughout this chapter. The selected factors are the ones that allow underlining differentiating characteristics in service provisioning and delivery among the three types of online video services. Services can be categorised by:

- the nature of service provider — broadcaster, pay-TV provider, Internet Player, online video aggregator, content producer and distributor, rights holder and CE vendor;
- the revenue model as described in section 4.5;
- the primary content offered to the viewer, as in professionally produced content. This factor has been selected since the type of content is strongly tied to the nature of the service provider and the chosen revenue model (e.g. although offered by the same provider, Sky Now and Sky Go present distinct content). Furthermore, on demand content, i.e. films and TV series, are widely offered throughout all types of online video services;
- the devices through which content is made available. While mobile devices (smartphones, tablets) are the primary target, there is also a clear intention in delivering content to the traditional TV-set through media players, Blu-ray players, gaming consoles or STBs. This factor also highlights that some services are also driven by strategies that tie the service to specific devices (examples include Disney Movies Anywhere on iOS and Android devices

and PlayStation Vue on PlayStation gaming consoles, to be further detailed in Sections 5.2.2 and 5.2.3, respectively);

- simultaneous streams, which allow service providers to impose control on the number of users that can use simultaneously the same subscription. For a number of services this information is not available or not applicable (i.e. for ad-supported services). Although certain services require devices to be registered (e.g. limited to up to 4 registered devices), the control point is made at the level of the number of simultaneous streams (e.g. some services allow up to 5 devices to be registered but only allow 2 simultaneous streams or distinct subscription fees are offered based on the number of allowed simultaneous streams (Netflix));

- additional device required, highlights the fact that some stakeholders introduce an additional branded device bundled with the subscription through which the service is provided.

Regarding delivery infrastructure, all three types of services are considered just from the point of view of delivery over the public Internet. All services may be accessed via fixed or mobile broadband, except for certain TV Everywhere services, which impose restrictions on mobile broadband access.

Finally, this chapter completed the first step of the adopted methodology, by identifying a generic value network, main business roles and actors, and a taxonomy of online video services.

The following chapter will first analyse the multitude of control points identified in expert interviews, and then derive business model configurations conceptualised on grouping control points around gatekeeper roles.

Table 4.3: Taxonomy of online video services.

	Nature of Service Provider	Revenue Model	Primary Content	Consumption Devices	Simultaneous stream	Additional Device Required
Video on Demand						
Hulu (Plus)	Rights Holders	Ad-supported (Subscription)	TV shows, films, kids, original content	Computers, tablets, smartphones, connected TVs, Blu-ray players, media players, gaming consoles	1	—
Crackle	Rights Holders and CE Vendor	Ad-supported	Sony-produced content	Computers, tablets, smartphones, connected TVs, Blu-ray players, media players, gaming consoles, STBs	N/A	—
Netflix	Online Video Aggregator	Subscription	TV shows, films, kids, original content	Computers, tablets, smartphones, connected TVs, Blu-ray players, media players, gaming consoles, STBs	Depends on subscription: 1 to 4	—
MUBI	Online Video Aggregator	Subscription	(less commercial) films	Computers, tablets, smartphones, connected TVs, gaming consoles	N/A	—
Wuaki.tv	Online Video Aggregator	Transactional	TV shows, films	Computers, tablets, smartphones, connected TVs, Blu-ray players, media players, gaming consoles, STBs	N/A	—
iTunes Store	Internet Player	Transactional	TV shows, films, kids	Apple devices, Computers, STBs	N/A	—
Google Play Store	Internet Player	Transactional	TV shows, films, kids	Android devices, Computers, STBs	1	—
Amazon (Prime) Instant Video	Internet Player	(Subscription) Transactional	TV shows, films, kids, original content	Computers, tablets, smartphones, connected TVs, Blu-ray players, media players, gaming consoles, STBs	1	—
Disney Movies Anywhere	Content Producer and Distributor	Transactional	Disney-produced content	Computers, iOS and Android mobile devices	2	—
Filmin	Content Producers and Distributors	Transactional, Subscription	(less commercial) films	Computers, tablets, smartphones, connected TVs, media players	N/A	—
UniversCiné	Content Producers and Distributors	Transactional	Independent films	Computers, tablets, smartphones	5	—
HBO Now	Broadcaster	Subscription	HBO-produced content, Hollywood films	Computers, Apple devices, STBs	Limited	—
CanalPlay	Broadcaster	Subscription	TV shows, films, kids	Computers, tablets, smartphones, media players, gaming consoles, STBs	5	Branded STB to stream to TV-set
Streampix	Pay-TV Operator	Subscription (free for pay-TV subscribers)	TV shows, films, kids	Computers, tablets, smartphones, media players, gaming consoles, STBs	N/A	—
Blinkbox	Pay-TV Operator	Transactional	TV shows, films	Computers, tablets, smartphones, connected TVs, Blu-ray players, gaming consoles, STBs	1	—
Live and Catch-up Linear TV						
BBC iPlayer	Broadcaster	TV licence	Linear live TV and catch-up, on demand films, download and keep for 30 days	Computers, tablets, smartphones, connected TVs, media players, gaming consoles, STBs	N/A	—
RTP Play	Broadcaster	Ad-supported	Linear live TV and catch-up	Computers, tablets, smartphones,	N/A	—
France24	Broadcaster	Ad-supported	Linear live TV and catch-up	Computers, tablets, smartphones, connected TVs, media players, Blu-ray players, STBs	N/A	—
HBO Go	Broadcaster	Included in Pay-TV subscription	HBO linear live TV and catch-up, on demand content	Computers, tablets, smartphones, connected TVs, media players, gaming consoles, STBs	3	—
CBS All Access	Broadcaster	Subscription	CBS linear live TV and catch-up, on demand content	Computers, tablets, smartphones, media players	2	—
Canal+ myCanal	Broadcaster	Included in Pay-TV subscription	Canal+ linear live TV, on demand content	Computers, tablets, smartphones, media players, gaming consoles, STBs	4	—
Sky Now	Pay-TV Operator	Subscription	Linear live TV (13 channels), sports channels or on demand films	Computers, tablets, smartphones, connected TVs, media players, STB	2	Branded STB
Sling TV	Pay-TV Operator	Subscription	Linear live TV (>20 channels) and catch-up, on demand, optional add-on packages	Computers, tablets, smartphones, connected TVs, media players, gaming consoles, STBs	N/A	—
PlayStation Vue	CE Vendor	Subscription	Linear live TV, on demand content	Sony PlayStation (soon on Apple devices)	3	Sony PlayStation
TV Everywhere						
Meo Go Multi	Pay-TV Operator	Subscription + Transactional	Linear live TV and catch-up, on demand content	Computers, tablets, smartphones	3	—
Sky Go	Pay-TV Operator	Free for TV package subscribers + Transactional	Linear live TV and catch-up, on demand content	Computers, tablets, smartphones	2	—
TWC TV	Pay-TV Operator	Free for TV package subscribers +Transactional	Linear live TV, on demand content	Computers, tablets, smartphones	N/A	—
Vodafone TV	Pay-TV Operator	Free for TV package subscribers +Transactional	Linear live TV and catch-up, on demand content	Computers, tablets, smartphones	N/A	—

Chapter 5

Control Points and Business Model Configurations

Subsequent to the identification of the value network and a taxonomy for online video services, this chapter proceeds with the second and third steps of the adopted methodology. The first section addresses the control points raised by interviewees, discusses the findings taking into account control points properties (i.e. interchangeability, demand, value and time) and the dimensions of value network and functional architecture, when appropriate, and identifies the nature of the control points (business, regulatory and technical).

The second section describes the third step of the methodology — the identification of gatekeeper roles. The VCDWG methodology proposes control point constellations as a way to pinpoint the major different ways that control can be exercised in the value network and underline how control points shape business model configurations. However, as the VCDWG methodology does not present straightforward guidelines on how to group control points, preference was given to group control points around gatekeeper roles (Ballon, 2009b). In a business model, a gatekeeper role exercises control but also adds value to the value network. The six gatekeeper roles established for this analysis encompass as much as possible the control points identified in Section 5.1 and thus intend to represent critical functions, which add value or originate control in online video services' business models. With the help of gatekeeper roles, the business model configurations proposed in this section discuss real-life cases of online video services and are presented per types of actors (as identified in Section 4.5).

5.1 Control Points: Findings and Analysis

Recalling the control point definition, this is an element at which control can be exercised, enabling an actor to demonstrate influence over other actors in the value network. In this study, the source for the identification of control points is in-depth expert interviews (c.f. Section 3.4). Subsequent to each interview, analysis took place, contributing to the refinement of the generic value network of online video services and to validate and cross-check facts and control points in upcoming interviews. This analysis stage was composed of coding control points and key factors influencing value creation, and using memos to document, summarise and interpret the most relevant information gathered in each interview (Strauss, 1987). ATLAS.ti [1] software was used to facilitate coding and memoing.

The control points presented in this section are organised by value stream — Content, Distribution, Application, Device, and Consumption — as is the value network presented in the previous chapter. The discussion takes into account interchangeability, demand, value and time properties and the way control points contribute to value network and functional architecture parameters as per Ballon's business model configuration matrix (c.f. Section 3.6).

Finally, an overview of the control points identified in the interview data is provided together with a classification on their modalities (business, regulatory and technical).

5.1.1 Content Stream

Licencing agreements

Licencing agreements for online video consumption are associated with consumer payment models and originate different types of deals in the relationship between rights holders and online video service providers. In addition, licencing rights are standardly bound to a specific territory/country. Three licencing rights models for online distribution have been identified by one rights holder respondent: transactional model (EST and rental), subscription model, and free to air and catch-up ad-supported model. The respondent noted that content offering for each of these models may vary considerably. Typically, the biggest blockbusters may never be licenced for subscription VOD and this is a common practice across all major Hollywood studios. For example, it is extremely unlikely that the Avatar film will ever be licenced on a subscription basis.

[1] ATLAS.ti website: http://atlasti.com

However, with regards to TVOD, all types of content are licenced and titles are not held back for digital distribution. This practice of differentiating content offered across licencing rights models is conveyed by the interviewee as part of the studio's strategies to monetise content as much as possible and to maximise the profits of every single piece of content produced by the studio. Therefore, for certain titles, the general thinking across studios (and not just this particular studio) is to continue to demonetise those titles by not licencing them for subscription services. As revealed by the interviewee, the fact these titles are not available for subscription, actually increases their value. If a consumer really wants to watch a certain title, she will pay for it, no matter its cost: "If the only way you can get Avatar is by paying €13.99 on iTunes, and you really want to watch Avatar, then you will pay for it".

Broadcasters respondents also highlighted that circumstances for online distribution are different from free to air distribution. For example, acquiring rights to transmit a series on broadcast TV does not guarantee the right to stream it online, neither live nor to make it available on catch-up after it has been aired. Specific rights that include online distribution need to be acquired for online video services.

Furthermore, a VOD service provider identified that often the bottleneck in licencing agreements actually resides on sales agents[2]. The respondent underlined that sales agents' business model is no longer sustainable, as they demand a minimum guarantee, an advance cash, that online video service providers are not willing to pay. The latter would actually prefer to share sales revenue instead. And although some sales agents already agree to a revenue sharing model, the respondent mentioned, as an illustration, that only about 10 percent of the 400 films presented at the Berlinale Film Festival each year are actually made available on online video services. Another VOD service provider highlighted that, at least in Europe, the situation is starting to change as there is a particular incentive from the European Commission targeted at sales agents to sell the rights of recent films (up to two years old) to online video services.

Besides being associated with consumer payment models, rights are also bound to a certain territory or region. Thus, an online video service provider operating in more than one country needs to licence each film or TV series (or bundle of content) for each country it operates in.

[2]Sales agents are the middlemen between producers and rights holders and they help producers selling films' rights to rights holders in multiple countries.

One VOD service provider noted territorial licencing greatly increases the complexity of the process of acquiring new content and to a certain extent limits any firms' intentions to internationalise to other countries. However, another VOD service provider representing film producers and distributors underlined that territorial licencing is the only way to guarantee that content creators and producers guarantee the necessary funds to produce a film, since film rights are pre-sold before production starts. The respondent was not a strong advocate of any European regulatory measures that would change current conditions and stressed that removing geographical restrictions would be great for global online video service providers, but would endanger European content creation/production and content diversity. Plus, territorial licencing is also key to localised marketing and promotion of a film. According to the respondent, promotion and marketing only works adequately if these activities are targeted at a country's specificities, language, culture, and adapted to its audience. Promoting a film on a global scale does not take into account each country's market situation and much less audiences' preferences. Also, film producers and distributors do not hold the resources or have the partnerships to market a film in various countries.

On top of this, another respondent underlined that, in the future, rights could potentially be licenced on the basis of the end-user device. For instance, content could be licenced to play on Apple devices, but not to play on gaming consoles. But this would add yet another layer of complexity to any online video service provider's operations.

Licencing agreements are thus a business control point between rights holders and online video service providers as they constrain the content offer depending on the adopted revenue model, create scarcity effects, and may additionally harness competition between services giving competitive advantage to services that, for instance, choose TVOD-based revenue models and thus have quicker access to the latest releases. Furthermore, they indirectly affect consumers, by limiting access to content based on the territory and the amount of money consumers are willing to spend. This control point is susceptible to change over time if there are regulatory measures or incentives targeted at relaxing the licencing process. However, the lack of harmonised legislation or incentives may actually disfavour competition between online video service providers operating in different countries or with a cross-border presence.

Release Windows

The content production and distribution industry business model relies primarily on releasing content in a sequential pattern of different periods of time, i.e. windows, for each distribution market. With this strategy, studios expect to fully exploit the value of content in each distribution channel independently, without cannibalising the potential profits of the other channels. This window strategy is therefore seen as a bottleneck for service providers that depend on content and as a price discrimination method, allowing to differentiate consumers by waiting time and distribution channel. But the widespread of digital innovation for content consumption as well as illegal alternatives has prompted distributors to reconsider the design of windows' timeframes. If online video services are subject to long window delays in relation to other distribution channels, users will tend to turn to illegal ways to access content faster and for free.

One rights holder respondent described European windows for films to consist of the following generic windows: the first window is theatrical and lasts between 90 and 120 days; the following windows correspond to transactional VOD and physical DVD and Blu-ray, separated about two weeks from each other, at the end of the theatrical window; only after about 6 months from the theatrical release, will content be available for a pay-TV window; the last window will last about 12 months and, depending on the country, content can be released on free to air broadcast TV or licenced for SVOD. This means that online video services content is firstly released on TVOD based services — potentially on pay-TV operators TVOD first —, then on SVOD, and lastly on AVOD.

The respondent highlighted that in the past five years, windows have been shrinking significantly. TVOD EST after theatrical window has gotten shorter and exclusive licence agreements with SVOD-based services, notably Netflix, are causing SVOD windows to start sooner. But this has triggered pay-TV providers to aspire for an anticipation of the start of their windows, and consequently the preceding TVOD window would have to shift accordingly. As the respondent contended, all players want to see the windows that affect their services to move earlier in time, knowing that in principle none can move earlier than theatrical. So the theatrical window is the wall that all stakeholders are pushing against, hoping that its duration progressively decreases.

On top of this, a VOD service provider lamented that, as a consequence of release windows, it is difficult to compete with a full pirate catalogue which contains more appealing content than the one offered by its service. The respondent stressed that it is not only windows that are a bottleneck, but other requirements too (e.g. DRM provisions, multi-device support) imposed by Hollywood studios, which make it hard for small online video service providers to be competitive. However, another respondent argued that windowing is one of the mechanisms that guarantees pre-financing of films and therefore windows should not be removed just because general thinking says Internet is a distribution outlet with supposedly many global customers. The respondent also noted that certain European countries have legislative provisions fixing the duration of windows[3] and also requiring public supported films to have theatrical releases.

This control point is likely to change over time, as content demand as well as service competition in online video services increases. As more services become available in the market, interchangeability will be facilitated, and online video service providers will fight for market share and survivability. As a pay-TV provider highlighted, “Netflix is not really a competitor” of its TVOD service, as “Netflix’s catalogue is not really attractive for consumers, apart from their own content House of Cards, mainly because it contains old content which does not have high value”. As a consequence, players such as Netflix and Amazon have embarked on efforts to produce original content and licence exclusive content for their services in order to attract viewers, increase services’ value and create points of competitive advantage (Wu, 2013; Curtin et al., 2014). Pressures coming from online video service providers to reduce the first window and to have simultaneous windows will increase. In fact, three of the eight films nominated for the 2015’s Oscar awards were released online less than three months after theatrical release and five films were released earlier than DVD (Granados, 2015). Most executives interviewed in the scope of the MIT’s Media Industries Project also confirm that they have been constantly reevaluating release windows (Curtin et al., 2014). But distributors’ eagerness to control how content is consumed will likely have them fight for release windows for some more years in the future.

Content aggregation

Interviewees interpreted content aggregation in multiple ways, although it is generally understood to consist of bundling content in packages or in a catalogue. Depending on the type of online video service, control points related with content aggregation gravitate around different actors.

Firstly, pay-TV operators see broadcasters limiting the quantity of content that can be made available online in TV Everywhere services. As pay-TV operators pay retransmission rights to broadcasters, when broadcasters do not own rights to distribute certain content online, pay-TV

[3] Portugal is one of such countries where window releases are regulated.

operators also cannot distribute that content on TVE services. Pay-TV operators often work closely with broadcasters managing blackout periods, replacing programs that cannot be distributed online by other programs. One pay-TV provider interviewee identified broadcasters and rights holders as having control and bargaining power over the negotiations of content licencing and revenue shares for pay-TV services delivered over the STB and over the Internet.

Secondly, TV Everywhere services are seen by broadcasters as restricting the choice of channels available to consumers, as not all the channels available through the set-top box are made available online. In a TV Everywhere service, the viewer has access to the content which is already presented as aggregated in the pay-TV service to which the consumer subscribes. In addition, channel choices can be further segmented to the consumer based on subscription packages (e.g. premium packages) and pricing. A pay-TV provider mentioned that the number of channels available on its TV Everywhere services is about half the one available through the set-top box, and that, to his knowledge, other TVE services also offer only a subset of the subscribed pay-TV channels. The reasons for this are twofold: first, the number of available channels online has been driven by audience share on the "traditional platform", with channels with higher share being made available online first and channels with niche content and small audiences being deferred; and, second, the investment on technology and supporting infrastructure for online video delivery is high. According to the respondent, it is significantly different to build and support an online platform with 190 channels or 80 channels, while adding more channels entails that provisions/measures need to be considered to make sure scalability of the technological platform is maintained. Nevertheless, the respondent further noted that the number of available channels on the online service has slowly increased since its launch, as it is becoming the norm to simultaneously licence rights for online distribution in pay-TV licencing deals.

Thirdly, aggregators[4] are seen by VOD providers as constraining the diversity of VOD catalogues. One VOD provider highlighted that it is often easier to licence content in bundles of rights from aggregators than to deal individually with sales agents or distributors. The respondent added that in many instances it is also more difficult to acquire content rights for European films than for U.S. films, as there is a great number of rights holders and sales agents to deal with for the entire European market. The U.S. market is better organised around a small number of suppliers and

[4] An aggregator is a type of actor which emerged to facilitate the collection in bundles of film rights which are then licenced/distributed to VOD providers. Under the Milky Way and Cinedigm are examples of such firms.

thus it is easier to acquire a bundle of rights for Hollywood films than for European films. Also, Hollywood films are seen as highly attractive content by younger audiences, so VOD providers end up giving preference to U.S. content. In addition, the respondent acknowledged that many European low budget or independent films are not part of content bundles, because aggregators select and filter content on the basis of content being attractive and saleable to audiences.

Finally, a broadcaster mentioned the potential of skipping aggregation and providing online video services directly to consumers. The respondent acknowledged that there is a little number of initiatives of rights holders and content owners so far, as there are several decisions and risks to be considered. As argued by the respondent the strength of the brand could be the decisive point. If the brand associated with the service is strong, offering services directly to the consumer may open doors to monetise content in a different way and to use audience data in the content creation process.

The control points associated with content aggregation mentioned by interviewees highlight how content is pre-selected and filtered by different types of actors and in various ways. This control puts these actors in a gatekeeper position influencing the choice and diversity of content that is ultimately delivered to consumers, although they do not always own a direct customer relationship. In addition, the role of rights aggregators in the context of VOD services constrain service differentiation, at least at the level of content catalogue. One can thus argue that the value of content aggregation control points is thus intrinsically connected with the actor that owns the gatekeeper role. Its value may change over time if aggregation functions are subject to regulatory measures, which would, for instance, enforce different levels of content diversity or consumer choice.

Content exposure

Most broadcasters conveyed the importance of content exposure in order to increase ad revenue and reach audiences beyond the traditional channel. In this context, broadcasters highlighted the increasing importance of aggregation platforms, such as YouTube, Facebook, Google. "They need content and we need exposure", one of the respondents highlighted. One way to address this is by partnering with content aggregation platforms, in order to drive users to broadcasters' content and online services.

Nevertheless, broadcasters expressed several concerns around these partnerships, especially the impression that in the future they will become more dependent on those players and in a disadvantageous position. They believe that it will be increasingly difficult for broadcasters to control the specifics of these partnerships in the future. Concerns are primarily related to how aggregation platforms control the means (e.g. search algorithms) to find content. If aggregation platforms change the way search algorithms work or favour certain content or provider, broadcasters' content exposure may decrease and they have little leverage power. In addition, broadcasters also highlighted these platforms are always in a strategic advantage as they gather and keep for themselves audience data, such as content trends, user profiles, recommendations, etc.

In case broadcasters, content producers and distributors prefer aggregation platforms to disseminate their content, this control point can change the value of content over time. Aggregation platforms assume a gatekeeper position in indexing content and in allowing consumers to find content, and consequently shape the level of content exposure. By this, they are intermediating between content creators/producers and the consumers that are looking for content. The practices in this intermediation may be not totally transparent for both sides, especially with regards to search bias and how aggregation platforms could charge content owners to favour certain content or manipulate search results.

The concerns over search bias have been voiced in the search neutrality debate and occasionally also in the scope of the net neutrality debate. In the search neutrality debate there are at least three (sometimes overlapping) concerns on the table related with search engine bias: (1) search technology is not neutral, but instead has embedded features in its design that favour some results over others; (2) major search engines systematically favour some sites (and some kinds of sites) over others in the lists of results they return in response to user search queries; and (3) search algorithms do not use objective criteria in generating their lists of results for search queries (Tavani, 2014). One can only argue that this scope can even be widen up to include not only search engines, but also content aggregator platforms which rely primarily on search algorithms to determine content result rankings based on some metric of relevance for a certain consumer.

Regulatory authorities in the U.S. and in Europe have been looking into Google's search bias potential practices from a competition perspective, but outcomes at this point are rather inconclusive regarding the potential damage caused to competing services. The U.S. Federal Trade Commission (FTC) spent two years scrutinising claims that Google would be favouring its own content in detriment of other websites. In 2013, the FTC concluded that although there was evidence that Google "likely benefited consumers by prominently displaying its vertical content on its search results page"[5], there was not sufficient evidence that Google "manipulates its search algorithms to unfairly disadvantage vertical websites that compete with Google-owned vertical properties" and consequently that there was no reason for an antitrust complaint (Lao, 2013). In April 2015, the European Commission announced charges against Google for abusing "its dominant position in the markets for general internet search services in the European Economic Area (EEA) by systematically favouring its own comparison shopping product in its general search results pages" (EC, 2015b) in breach of EU antitrust rules. The EC gave Google 10 weeks to reply and present a defence[6].

Although search bias can have a negative impact on content exposure, hindering competition and harming consumers, it seems largely difficult, on one hand, to prove that these search bias practices occur, and on the other hand, to impose neutral search algorithms to content aggregators. It remains to be seen if regulatory actions would be needed to protect consumers and content producers.

5.1.2 Distribution Stream

Internet Distribution

The concerns over Internet distribution are mostly related with its costs by comparison with traditional TV distribution, and the need to have mobile broadband networks fit for video delivery.

As one broadcaster declared "traditional" broadcasters are less prepared to consider Internet distribution than firms that already control last-mile delivery such as pay-TV providers or broadband providers. As the respondent stressed it is more expensive, for about a factor of five, for a broadcaster to deliver a unit of linear TV over the Internet, compared to delivering the same unit over cable or terrestrial TV. If a broadcaster wants to go online with a significant amount of viewing time, it will require a high investment, which will clearly have a significant operational impact, especially if the associated costs cannot be offset with an increase in advertising revenues.

[5] Vertical search engines are substitutes for general search engines for specific products or services' searches, e.g. TripAdvisor for city highlights and accommodation, SkyScanner for flights, etc. An example of Google's vertical content on search results consists of the following: when a user queries for a certain street name on Google's search engine, the first result is an integrated map provided by Google Maps. Google does not let the user select an alternative map provider (e.g. Mapquest, Bing Maps, etc.) to display the search result.

[6] At the time of writing, there was not an official reply from Google.

Therefore, broadcasters may have less incentives to build an online video strategy than other players, such as pay-TV operators with verticalised broadband service provision. The latter are well positioned to benefit from any online operations, whether customers churn or ad revenues do not grow, as they are able to offset a decline in pay-TV revenues with a potential increase in broadband charges. The players which control the required assets for Internet distribution and have vertical integrated operations will be in an advantageous position to leverage its customer base and launch online video services.

Also mentioned by broadcasters and a pay-TV operator are broadband networks. In specific, mobile broadband networks are seen both as a key factor and a bottleneck for online video services to thrive. With advances in mobile devices, more people using smartphones and more demand for content, networks should develop accordingly to support more video traffic and related features. Respondents pointed at mobile broadband operators for not being able to handle traffic originated by high quality video delivery, for charging users excessively, and for limiting mobile data plans. According to respondents, these factors justify the difficulty in building a business case based on high quality video delivery. To circumvent this bottleneck, a potential business workaround would be to offer downloads instead of streaming as a prime service, so that users can watch primarily in offline mode when using a mobile broadband connection. Another option is for mobile operators to upgrade their networks to 4G (and future 5G), but this could be compromised by lack of financial resources to pursue such upgrades. This latter option may be the driver for mobile broadband operators to build a bargaining position that demands additional payments to online video service providers and CDNs for delivering high quality video with minimum delays. Therefore, as underlined again by respondents, the players controlling the scarce and critical resources for Internet distribution will have a bargaining position to stipulate market conditions and shape user experience, while being in an advantageous position to launch their own online video services.

Content caching

Related with content caching (i.e. positioning content near the consumer) respondents mentioned two issues as potential points of control. Firstly, online video service providers see CDNs as key in the provision of caching resources and distribution capacity for delivering content, therefore they acknowledge their growing dependence on CDNs to improve users' quality of experience for live and on demand content. A broadcaster highlighted CDNs' role in managing problems of scalability and capacity, especially for live feeds. Although no information was provided about the actual costs incurred with CDN services, the respondent mentioned that typically costs depend on the traffic processed by the CDN. Respondents underlined that CDN providers are holding to a dominant position to improve online video services' experience and are concerned with potential changes to CDNs' business model or pricing structure, which can negatively hamper online video service providers if they cannot cover additional demands or increasing costs. However, a CDN provider rejected this dependence arguing that for an online video service provider wanting to change CDN providers the switching costs were very low compared to, for example, changing ISPs.

Secondly, one respondent underlined the lack of transparency of ISPs towards online video service providers wishing to host their own caching servers at ISPs' premises. The interviewee argued that several ISPs host servers from big VOD providers, but often reject access to smaller online video service providers. The respondent contended this type of preferential treatment should be remedied in some way, potentially by regulatory measures, if transparent business negotiations around the terms under which ISPs host caching servers cannot be attained. Another respondent declared that these relationships with ISPs are often based on who holds the strongest market power. As an example the respondent mentioned that big eyeball ISPs would tend to charge small to mid-size CDNs for hosting their servers, while a small ISP may feel forced to accept hosting servers from a big CDN without any financial compensations. In addition, if there is a dominant ISP in a country, it may be more expensive or more difficult for a CDN to connect to that ISP. The respondent revealed that business deals between ISPs and CDNs frequently do not involve any financial compensations, as it is often in ISPs' interest to host and interconnect with a CDN in order to reduce network traffic at its backbone. Therefore, these individualised deals resemble to some extent the peering agreements between ISPs. Worth highlighting that peering agreements are not regulated, but are subject to market dynamics and individualised arrangements between providers. In relation to these agreements, one broadcaster raised concerns about potential future scenarios in which ISPs could charge unbearable values for hosting CDN servers, which would potentially have collateral effects on online video services using CDNs.

Both concerns presented are valid and indeed reveal that CDNs and ISPs control the key resources for last-mile content delivery. Therefore, these players hold the market power *vis-à-vis* online video service providers to introduce preferential treatment practices or to establish differential (financial) conditions depending on the market share (or other conditions) of online video service providers. Typically, higher market share implies more users requesting video traffic and thus congesting eyeball ISPs networks. From the point of view of online video service providers, interchangeability of ISPs or CDNs may not be easy as there might not be other ISPs or CDNs that provide reachability to the same group of consumers.

Traffic management

With regards to traffic management and potential issues related to network neutrality, only one interviewee addressed concerns that could have collateral effects on its business.

A broadcaster raised concerns about ISPs' control over CDN traffic and how ISPs could throttle CDN traffic or prioritise their own online video services' traffic over CDN traffic. This would endanger the quality of service of many online video service providers, which primarily rely on CDNs to improve quality of delivery to the consumer. The respondent argued that net neutrality regulation or other regulatory measures should prevent potential abuses of power in the relationship between ISPs and CDNs.

As noted in the description of the previous control point, ISPs are also hosting online video services' servers, therefore ISPs could actually embark on practices to weaken the competition. Limiting CDNs access to their networks or prioritising their own video traffic over (certain) CDNs' video traffic could be restricting practices implemented by ISPs in the future. These practices would indeed have an impact on CDNs' businesses and on the online video service providers contracting CDNs, and ultimately have an impact on the quality of service provided to consumers.

5.1.3 Application Stream

Application Development

Several respondents amongst broadcasters, pay-TV operators and VOD providers mentioned the complexity of developing applications for tablets, smartphones and connected devices across the multitude of operating systems and devices.

In order to develop an app for an operating system, developers need to use a Software Development Kit (SDK) which is often made available by the Operating System (OS) Vendor. Since the life-cycle of the various versions of most operating systems usually overlap, meaning that in any moment there is more than one supported version of the same OS, this often represents using multiple SDKs to comply with all OS releases and versions.

Respondents underlined the difficulty and high investments in developing an application that has the same look and feel and features across all operating systems and devices, since each OS may support different features in what concerns DRM, streaming technologies and video players. It was also underlined the immense amount of time and investment dedicated to updating applications each time a new OS release or version is launched, especially in the case of Android. As one respondent noted, considerable more time and effort is dedicated to updating and testing the apps every time there is a new OS version, which are not otherwise spent on developing new service features. A respondent stressed that developing these apps in-house, has created additional overheads in research and development (R&D), while another respondent mentioned that R&D costs related with app and website development represent the second highest expenses after content licencing costs, and more than marketing costs.

Altogether, respondents emphasised the considerable costs of application development, much due to multiple SDKs and versions of the same operating system, becoming to some extent unbearable to keep up with the fast pace of new operating systems' releases. On top of that, and at the same time, old versions of the operating systems get deprecated and put into an end-of-life state, but that does not necessarily mean that a considerable amount of the customer base immediately shifts to a newer version. Service providers thus need to constantly assess how much development effort and costs would be involved in keeping support for old OS versions and supporting the newest OS version. Assessments are mostly based on current customer base or specific device adoption rate in a certain market/country.

Application DRM Support

DRM support on applications often involves several business deals and development steps. When an online video service provider chooses the DRM technology(ies) to protect content according to content providers' requirements, which also satisfies wide reach on multiple devices, it has to reach deals with a DRM technology provider and a DRM service provider. The first, the DRM technology provider, has earned a patent for the DRM technology, provides an SDK to use the technology in a software application, and may require the payment of royalties each time the technology is used. For instance, for PlayReady DRM, Microsoft requires a one-time advanced payment of $30 000 for royalties when incorporating PlayReady in a software application (Microsoft, 2015). Additional royalties are due when such application, downloadable from publicly available appstores, first receives PlayReady protected content (Microsoft, 2015). For example, each time MEO Go app is downloaded from the iTunes store and the user watches (PlayReady protected) content, $0.35 of royalties need to be payed to Microsoft.

To protect each video asset to be made available in a software application, access to a licence server that issues DRM licences is required. This licence server can be hosted in-house or be provided by a DRM service provider, such as BuyDRM. This DRM service provider offers a kind of DRM server-as-a-service, meaning that it runs DRM licence servers for multiple technologies, say PlayReady and Widevine licence servers, and then charges customers on the basis of individual DRM licences issued. Each video asset may need to be protected with multiple DRM technologies depending on the streaming technologies and supported devices. Therefore, during content transcoding multiple files for a certain video asset may be generated each incorporating a different DRM licence. Once the video file is played within the application, the application connects back to the DRM licence server to validate the licence and the associated rights.

Several respondents mentioned that the necessary licencing processes and the fees involved in setting up DRM were the main entry barriers for new online video services. Therefore they stressed the prominent role of DRM service providers in facilitating the support of multiple DRM technologies, while underlining that the switching costs in changing DRM service provider were high as it required new investments and application development. Much due to the complex process and the investments involved, interviewees also acknowledged that DRM limits the availability of the online video service on multiple devices and therefore has an impact on the service's adoption rate. Other respondents also highlighted the importance of choosing the DRM technologies with the wider adoption rate across devices and operating systems, as this would facilitate meeting rights holders requirements and incorporating more content in the content catalogue.

Currently this control point associated with DRM appears to limit online video services' value, but with time this technology fragmentation might no longer be an issue since DRM implementation might become a non-mandatory requirement imposed by rights holders. Although the essence of this control point is of technical nature, it has also created business barriers and bottlenecks.

5.1.4 Device Stream

Device DRM Support

This control point is related with DRM support on devices. In the same manner as for software, upon CE device development a CE vendor needs to licence DRM technologies and pay the associated royalties. A certain device can only play DRM protected content if the DRM technology with which content was encrypted is available in the device in order to decrypt the content and validate the licence against the licence server.

Online video service providers' concerns are mostly related with CE vendors adoption of DRM technologies. In specific, respondents mention the uncertainty associated with the diversity and quick spread of connected devices, while for mobile devices the market is less fragmented and is focused around a few operating systems. They acknowledge vendors cannot support all technologies but wonder what will happen if a certain DRM technology becomes dominant and a wide range of legacy devices do not support that particular technology.

Therefore, from an online video service provider's perspective, given the slow adoption and the current market shares of connected devices, investing time and financial effort in developing an application for a certain connected device needs to be well planned and has less priority than for a mobile device. In addition, the ecosystems around connected devices (e.g. smart TVs and digital media players) seem more controlled by CE vendors and less open to application innovation than the ones for mobile devices.

Operating system

As already mentioned for application development, operating systems greatly influence R&D expenses of online video service providers. Various interviewees mentioned the importance of covering the most important operating systems to reach the widest audience.

Several respondents also highlighted the difficulties and differences in developing for devices running Apple iOS and Google Android operating systems. As iOS is a proprietary and closed operating system, developing and distributing applications for iOS is to a certain extent easier, since an application developed for a certain iOS version will have the same behaviour in all Apple devices. In contrast, respondents mentioned there is a great fragmentation amongst devices running Android OS. As Android is an open operating system, CE vendors are allowed to customise each version with a branded user interface and specific vendor apps. But this causes applications to have an inconsistent behaviour while running on the same Android version but in different CE device brands (e.g. Samsung, LG, HTC, etc.). Therefore respondents underlined that for Android devices a "develop once, deploy everywhere" scenario is not applicable. As a consequence, application developers consistently spend more time testing and updating applications developed for Android than for iOS, in order to quickly address bugs or problems raised by users.

An interviewee argued this control point will not exist in the future as standalone apps for computers and mobile devices will slowly be replaced by interfaces developed in HTML5 specification. HTML5 will support the necessary video requirements (DRM, streaming technologies, etc.) and thus allow online video services to run directly on responsive websites in any browser, independently of the operating system.

Although a potential shift in technology appears to overcome the control exercised by OS and CE vendors, it seems however that this control will in fact shift to Web browser developers. The past decades reveal an extensive record of Web browsers not being fully compliant with HTML specifications, thus causing websites to display and behave inconsistently throughout browsers. Schrock (2014) analyses recent key disputes over HTML5, one of them being about multimedia support — video players and DRM support. As DRM support would be enabled as an HTML5 plug-in, Schrock argues that it would allow each browser developer to set their own methods for plug-in support, thus also leading to fragmentation of DRM support in browsers.

Application Provision on Connected Devices

CE vendors of set-top boxes, media players, Blu-ray players, and other devices which enable content to be displayed on the TV screen, as well as of smart TVs, are considered to be gatekeepers of the apps/widgets which are bundled on these connected devices. They control the user interface, the "landing portal" once the device is turned on, and choose which apps are incorporated on devices. CE vendors usually partner with online video service providers (e.g. BBC, Netflix, YouTube, etc.) to have their widgets and apps pre-installed on devices. In doing so, several respondents also pointed out that CE vendors select/limit content exposure and the choices of consumers in terms of access to aggregated content. As one respondent noted "When you turn on a Samsung TV, you see the Samsung portal and not the first TV channel".

Although these connected devices are closed, a rising developer community reports ways to jail-break or hack devices such as Apple TV, Western Digital, and others, in order to add additional features like access to a web or FTP server, Bit Torrent and game emulators. This situation resembles, years ago, when many users ended up jail-breaking their iPhones in order to unlock the limitations for the installation of certain applications, such as VoIP clients (Herzhoff et al., 2010). Also for smart TVs, there are a number of apps available for smartphones which connect to the TV and enable the TV to show any content selected on the smartphone (from Facebook, YouTube, Picasa, or a local media server) and thus breaking the walled garden of apps pre-installed on the TV.

As a broadcaster mentioned, the apps bundled in a device are also considered by CE vendors to be a selling point. In fact, that demonstrates this control point interchangeability, as it is easy for a consumer to look for an alternative device which gives access to the desired content and online video services. For this reason, this broadcaster highlighted its power position towards CE vendors, by running an app certification process which ultimately allows the broadcaster's app to be incorporated on that device. The broadcaster makes available its app to a CE vendor, the latter then does all the development work to incorporate the app on its devices. The broadcaster then tests the app on the device and makes sure the app is working under an acceptable stand, allowing or not the CE vendor to bundle the app in its devices. The broadcaster acknowledged this might be an exceptional position influenced by its strong brand and content, and might not represent commonplace in the relationship between online video service providers and CE vendors for app development and integration.

Connected devices may be considered control points for application provision, as CE vendors may use them as a way to limit which apps and content users can have access to, restrict online video services' exposure and keep audience data (e.g. users' viewing habits (Constantin, 2015)). CE vendors are intermediating services which are in many instances already intermediating other services which aggregate content from several sources and content producers, such as Hulu, Netflix, YouTube. By keeping audience data, CE vendors build strategic advantage towards online video service providers and content producers.

For services that require a registration and payment, CE vendors are also controlling the billing relationship with users that sign-up for a service via the device. CE vendors then share with online video service providers a percentage of the subscription or one-time payment. Follow-up changes to billing information and cancellations are handled via the device or specific apps/portals provided by the CE vendor.

In the long run, as both CE vendors and online video services providers are looking for market adoption, they need each other to grow. CE vendors need compelling content to thrive, and online video service providers wish to broaden up their audiences, if that means being available in numerous devices. This control point may, however, be subject to change as power relationships alter. In the future, certain CE devices will become dominant over other devices, as well as certain online video services over other services. Revenue sharing agreements and application placement in CE interfaces will likely reflect these shifts in bargaining power.

5.1.5 Consumption Stream

Source of revenue and information

Most respondents acknowledged that the consumer is their source of revenue, easily affected by network externalities, highly driven by pricing, or rather free content, and that many users are still discovering and experimenting with online video services. Demand is increasing over time, but interchangeability is fairly easy as there are many competing services, with some offering free access to content.

Several respondents recognised that pay-TV and broadcasters' applications and content offering have to be attractive enough to drive viewership away from YouTube and Facebook, not to mention "pirate" websites. Over time, the collective revenue from viewers may change as they can easily switch to cheaper services or whatever service offers at a certain moment the most attractive content. Among broadcasters and pay-TV providers there is a common view that the most attractive content consists of Hollywood feature films and U.S. TV series. For this reason, pirate websites and respective aggregators, such as Popcorn Time[7], are regarded as competitors, since the most recent content can easily be found in these pirate networks.

Although it may not be considered a tangible revenue, direct customer ownership is acknowledged as extremely valuable, as it allows to gather audience information, viewers' preferences and enables providers to monetise customer information and attention through advertising. Therefore,

[7] Branded as "Netflix for Pirates", Popcorn Time is an app that allows the user to browse through an immense catalogue of films and TV shows and stream the selected content from torrents available on P2P networks (McDuling, 2015). Popcorn Time's popularity is essentially due to its easy to use Netflix-style interface and the aggregation of the latest just released film (or just aired, in the case of TV series). It takes piracy to a new level, as it provides a friendly and clean interface to search and stream illegal content. Netflix's CEO recently admitted the concern over the sharp rise of Popcorn Time usage in countries where Netflix had recently been launched (Ernesto, 2015; Netflix, 2015b).

whoever controls the customer relationship (e.g. CE vendors) is able to gather additional revenues, which are not directly related with service provision. However, the value of this control point is prone to change in the future as copyright and privacy concerns become increasingly important from a regulatory point of view.

Service bundling

Since pay-TV providers are often at the same time broadband service providers, they have a central role in bundling services. Over the years, cable, satellite, and telecom providers have concentrated significant assets which allow them to lock-in consumers in a service package including TV, Internet and phone access for a single monthly subscription fee. Two respondents highlighted that often customers find bundles quite convenient. A typical consumer does not just subscribe to broadband, when the price difference between a subscription which includes broadband access only, and one which includes both broadband and pay-TV is so small. Then why not choosing the latter? — "I might actually watch TV a couple of times, one thinks.". One respondent thinks the "cord-cutting epidemics is a bit overstated", at least in Europe, rightly because of service bundles. Even if subscribers are not consuming many hours of TV, they still subscribe a whole package that includes TV. More often than not, consumers keep their subscriptions not for the value of the services they are using, but for the convenience and possibility of using them at some point.

In addition, in Europe many service bundles are being used by pay-TV service providers to upsell VOD (especially TVOD) and show consumers that their VOD content offer can compete with other VOD services available in the market. One respondent argues that standalone subscription-based online video services have not been incredibly successful, since they are in a disadvantageous position compared to pay-TV providers. The latter stakeholders usually hold a large customer base, a strong brand and provide easy and integrated access to VOD content on pay-TV bundles.

Since most providers concentrate the required assets and have verticalised their offer of TV, broadband, phone and online access, the consumer is locked-in in bundled subscriptions and in many instances subject to contract agreements with a fixed minimum duration. Interchangeability is limited, but possible only after a certain period of time or subject to breaking rules, as there are alternative providers. This control point is subject to potential changes in the future either because of business or regulatory evolutions. On the business side, examples of "smaller" TV packages (e.g Sling TV, Sky Now) with less channels and cheaper monthly fees are starting to emerge, as well as examples of standalone and *à la carte* channel offers (e.g. HBO Now, CBS All Access). These examples are not, however, solutions to protect consumers, but rather reflect the competitive dynamics around video/TV content and how players are making efforts to reduce churn or establish a direct customer relationship. At policy level, in March 2015, the Canadian Radio-television and Telecommunications Commission has issued legislation limiting the price of basic cable TV packages to $25/month, which can then be supplemented by *à la carte* channels or small reasonably priced channel packages (CRTC, 2015). This type of legislation may also be adopted in other countries to limit the increasing price of bundles.

TV Everywhere access

As noted in the previous chapter, access to many TV Everywhere services is limited to usage within the providers' broadband network or home WiFi network. According to a pay-TV provider, two issues are at the root of this control point. Firstly, on smartphones and other mobile devices, consumer data access plans on 3G and 4G networks are still very costly. Therefore, the pay-TV provider underlines this limitation as a protective measure for the consumer, to not let him incur in high data traffic costs at the end of the month. Secondly, as TV Everywhere platforms are still maturing from a business point of view, pay-TV providers are concerned with service adoption and providing the best possible user experience, so that viewers are not driven away to other online video services. Yet these platforms are also still maturing from a technological point of view. As pay-TV providers are aiming for robust platforms which can support thousands of users, they prefer to contain access within their networks with guaranteed quality of service, good user experience and availability.

However, the same respondent did not provide a justification for limiting the amount of free traffic, even if the user is using the pay-TV provider's 3G network. Several pay-TV providers establish monthly data caps, even if the user is using the TV-Everywhere service within the provider's (mobile) broadband network. For instance, Vodafone Portugal TV Everywhere service is limited to a 2-hour usage over the 3G or 4G operator's network. Beyond that limit, the consumer is charged 2 Eur per hour for using the service over the mobile broadband connection. In this case, one can only speculate that the provider is using value-added services to payback the investments on mobile network infrastructure.

As previously underlined, pay-TV operators have verticalised TV and broadband access, often both fixed and mobile access. For this reason, in TV Everywhere services, the pay-TV operator is seen as a gatekeeper for broadband, TV, application and online video consumption controlling customer ownership.

Simultaneous streaming streams

As mentioned by pay-TV providers and VOD providers several services limit the amount of simultaneous streams per user account. This limitation was created to prevent users from sharing their password accounts with multiple users, which were creating numerous streaming requests without generating additional revenues. With simultaneous streaming limitations, users are still allowed to share accounts/passwords, for example, amongst family members and friends, but the number of active streams per account is limited to typically 3 to 4 at the same time.

This control point towards end-users is based on the creation of the impression of artificial scarcity in order to maximise profits, as there are no factual technical constraints which impose such limitations. However, interchangeability of this control point is high, as users can easily switch to a similar service which allows a higher number of simultaneous streams. The analysis of the characteristics of online video services undertaken in the previous chapter also revealed that, on top of the limitation of simultaneous streams, several providers also require the registration of the specific devices that will access the service. Not only registration is required, but a maximum number of devices is allowed and a registered device can only be replaced by another device after a given period of time. With time, as online video services become widely available and prices go down this control point may no longer be considered by online video service providers, since users will not see any advantage in sharing access to services.

5.1.6 Summary of findings

This section presented a number of control points identified by experts in in-depth interviews. In general, these control points were raised mostly as bottlenecks, as gatekeeper points, affecting the business and development of online video, although it is clear that many experts also raised issues deeply intertwined with their originating sector — film, broadcasting, telecommunications and Internet sectors. This provides an evidence that many online video services are still evolving and are a result of an amalgam of traditional and new players and services.

The grouping of control points by business stream was not merely because it seemed functional, but because it became clear during the course of the interviews and their subsequent analysis, that control points gravitated around a few actors, which hold critical resources, make efforts to exert control over others or presumably hold more power in influencing or limiting other actors' activities.

Most control points identified by respondents are related with technical or business issues they (and the actors they represent) are facing (Table 5.1). Less emphasis was given by interviewees to current sector-specific regulation which could form a control point, in the sense of, for example, current regulation producing undesirable effects or creating bottlenecks in service provision. However, in several control points, interviewees suggested that regulatory measures could help or could be needed to overcome certain tensions and bottlenecks. This suggests that since online video services are still at an early stage of development, organisations are reconfiguring themselves and adapting, the market is still very much self-regulated and regulation plays little influence in the current market dynamics.

Table 5.1: Summary of control points for online video services.

Content	Distribution	Application	Device	Consumption
• Licencing agreements (B) • Release windows (B) (R) • Content aggregation (B) • Content exposure (B) (T)	• Internet distribution (B) (T) • Traffic management (B) • Content caching (B) (T)	• Application development (T) • Application DRM support (B) (T)	• Operating system (T) • Application provision on connected devices (B) • Device DRM support (T)	• Source of revenue and information (B) • Service bundling (B) • TV Everywhere access (B) • Simultaneous streams (B)

(B) Business; (T) Technical; (R) Regulatory

In the content stream, rights holders, sales agents, distributors, stand out as exercising control over the most valuable asset, i.e. content, for online video service providers. This positioning gives them the power to establish the "business rules", create scarcity effects, influence competition between online video service providers and create entry barriers for small players. It indirectly affects how content reaches consumers, potentially having been subject to selection and filtering. But the maturity and growth of online video services is expected to put pressure on the terms and conditions imposed by content and rights owners.

As for Internet distribution, most respondents acknowledge the differences in costs and procedures when compared to other media distribution channels. Several respondents see CDN providers as key actors in controlling the necessary resources for Internet distribution, while other interviewees recognise that beyond CDNs, eyeball ISPs are in fact controlling the direct relationship with consumers and with transit operators, thus being in a key position to shape traffic management and compete in online video services. Mobile operators are regarded as restraining the business case for high quality video delivery, essentially for two reasons: mobile networks cannot yet cope with an increase in traffic demand, and operators have created artificial measures, e.g. data caps and expensive data plans, to curb online video consumption.

Although the control points in the application stream are essentially of technical nature, they seem to limit the value of online video services and create additional R&D efforts and investments for online video service providers. By creating constraints on the availability of services on multiple operating systems and devices, these control points also impact services' adoption rate and user experience. In addition, the technical burdens and associated costs also appear to create entry barriers for small online video service players.

In the device stream, CE vendors and OS vendors are regarded as the main sources of control given the fragmentation of OS versions and the uncertainty over the future adoption of streaming and DRM technologies. The emergence and diffusion of connected devices also reveals the creation of new walled gardens, since CE vendors are positioning these devices as a source of audience data and a source of revenue from online video services. CE vendors are also becoming the gatekeepers of the applications bundled on the devices and the billing relationship established with consumers.

Finally, in the consumption stream, power lies with the actor(s) who own a direct customer relationship and/or who own an established customer base. A direct customer relationship gives an actor leverage to monetise audience information and viewers' preferences, while establishing an additional source of revenue. An actor with an established customer base has the strategic advantage to upsell online video services and experiment with consumer bundles, in order to raise online video services' adoption.

Based on these control points, the following section will identify gatekeeper roles, which, in their turn, contribute to the design of different business model configurations.

5.2 Business Model Configurations

As suggested by the VCDWG methodology, control point constellations, i.e. groups of control points, represent each of the major different ways that control can be exerted and show how control points shape business model configurations. Each business model comprises a particular organisation or configuration of the prevalent control points and the actors which are likely to assume gatekeeper positions. Therefore, business models differ in terms of the relationships between individual control points, and how and by which actor(s) value is generated. However, as the VCDWG methodology does not present straightforward guidelines on how to group control points except for arranging control points in a logical sequence, depending on how tightly or loosely coupled the components are and on how integrated are certain control points (Klym, 2005; Klym and Trossen, 2006), preference was given to group control points around gatekeeper roles. Ballon (2009b) introduces the concept of gatekeeper role within the context of mobile service delivery business models to analyse which actors exert most control in a value network. Ballon advances that gatekeeper roles not only exercise control, but also add value as they "not only filter and select information but also qualitatively alter the informational content through active accumulation, processing and packaging" (Ballon, 2009a). In the context of mobile service platforms, Ballon (2009b) concludes that gatekeeper roles are crucial in developing strategies which expose information resources and thereby attract customers, while controlling and locking-in various types of customers.

Seen the varying competing online video services available in the market and the grouping of control points by value stream as previously presented, it is hypothesised that business model configurations will revolve around gatekeeper roles pertaining to the value streams. Therefore, with the exception of content which has been split in two gatekeeper roles due to their relevancy, the remaining gatekeeper roles are related with a single value stream.

- Content development and rights management *(content stream)*: are essential in establishing practices which define how (distribution channels, i.e. service types) and when (time, i.e. windows) video content reaches consumers. Business actors may develop, produce and own rights for content or acquire rights for content produced by others. As previously discussed, owning rights for content allows a provider to create service value. But current licencing practices, in particular the ones establishing windows and geo-location restrictions, create bottlenecks for online video service providers, since they allow some services (e.g. EST-based revenue models) to achieve competitive advantage over others (e.g. SVOD-based revenue models). In addition, there is also an added complexity in case the online service provider operates in several countries;

- Content aggregation *(content stream)*: in its simplest form allows content to be bundled in packages which are presented in the same manner for all consumers. Advanced aggregation implies filtering, customising and recommending content to each consumer. Content aggregation is a crucial value-adding role, as it is the basis for differentiation amongst services allowing viewers to identify the services which offer the content they want to watch. On the other hand, it may be seen as a gatekeeper for content diversity, while also influencing the viewers to consume certain content in detriment of other;

- Content storage and delivery *(distribution stream)*: these components are important in content distribution over the Internet and, among other factors, they influence how consumers perceive the service's quality of experience. Business actors may hold the resources to store content and cache popular content closer to the consumers or they must rely on other actors providing those services. These components may also be potential bottlenecks if along Internet delivery, video packets are differentiated. Therefore ISPs hold bargaining power to discriminate traffic and demand payments from caching providers and online video service providers;

- Service cross-device integration *(application stream)*: a set of development tools and DRM technologies which allow services to be accessed on multiple devices. Business actors develop the necessary applications, each with its own specificities, so that services are available on computers, mobile devices and connected devices. This component actually defines and limits the availability and diffusion of online video services across devices and adds value to user experience and convenience. At the same time, it is also a bottleneck for online video service providers as it requires knowledge and investment in mastering or procuring several development environments. But it may also be seen as a business opportunity by technology firms, since many online video service providers do not hold large technical departments to develop applications;

- Audience management *(device stream)*: manages consumption data, preferences and information about consumed content within one or more services. Audience information is typically assessed at application level and managed by online video service providers. However, data collection is often intermediated by the device or operating system where the application is being used, so the quantity and quality of information made available to the application level may depend on other actors. Audience data is a source of added value and of competitive advantage as it allows service providers to develop personalised experiences and may be used as valuable information to sell targeted advertising. In addition, it may also be used to provide feedback to and influence content creation;

- Service provision/brokerage and billing *(consumption stream)*: the reference point for consumers to access, pay or subscribe online video services. Services may be provided directly by the individual online video service provider or otherwise via a brokering actor. In the latter setup, the broker may control the billing relationship with the viewer, and in that case, not only holds customer ownership, but is also in control of the revenue sharing model and thus guarantees bargaining power over the service provider.

The following business model configurations are conceptualised as different representations in which online video service providers (with reference to Figure 4.13) combine a number of different roles. Each business model configuration is thus centred on online video aggregators, content producers and rights holders, CE vendors, Internet players, pay-TV operators, and broadcasters. Such representation should allow to shed light on the positioning of these actors across different types of online video services. The current nature of the market may lead to various subjective actor categorisations of the stakeholders used as illustrative examples in the configurations. For this reason, it is acknowledged that, in practice, stakeholders currently perform so many different functions within the value network, that attempting to categorise a player under a certain actor may be an oversimplification. The selected real-life examples are purely illustrative and the data gathered for discussion is based on in-depth interviews and desk research.

In the configurations presented in the following subsections, full black arrows indicate service flows between actors, while the white arrows indicate financial flows. Due to peering and transit agreements, there are often no financial exchanges amongst eyeball ISPs, transit operators and between eyeball ISPs and transit operators. Although generic financial arrows have been drawn between these actors, in practice, these business relationships are established on a case by case and financial contractual agreements may differ depending on the stakeholders involved. Moreover, in the majority of cases there are no financial exchanges, at least for traffic, in direct connections between eyeball ISPs and CDNs, as both parties benefit from this relationship. Eyeball ISPs while hosting CDNs servers, obtain direct access to content, which translates in better serving their end users, and not having to incur in further costs to interconnect with CDNs. Otherwise, eyeball ISPs may interconnect indirectly with CDNs via transit operators or IXPs. Hence, in the business model configurations there are also service and financial arrows between ISP and IXP, ISP and transit operator, CDN and transit operator, and CDN and IXP. As mentioned by BEREC (2012), the increasing diversity and heterogeneity of the Internet architecture and its stakeholders has contributed to intensify the variety of interconnection arrangements. As a result, one can contend that the hierarchical structure of the Internet has flattened and the bulk of Internet traffic no longer moves across tier-1 transit providers as there are many direct connections between stakeholders taking place at IXPs.

Since the content is delivered over the open Internet, one could argue that online video services are not bound to any specific broadband access provider. However, most pay-TV operators' TV Everywhere services leverage on operators' market power and are bound to an artificial scarcity which in fact limits TV Everywhere access to the operators' networks.

5.2.1 Online Video Aggregators

The following business model configuration characterises VOD services taken up by new players in the online video market (Figure 5.1)). Real life examples include services such as MUBI, Wuaki.tv and Netflix. In this configuration, most of the roles are taken up by other actors, thus placing the online video aggregator in a position of high dependence on other actors.

In this business model the consumer can access the VOD service through the webpage of the service, via a mobile application downloaded/purchased from an (OS/CE vendor) appstore or via a connected device. The consumer pays directly to the online video aggregator, except in case she subscribes the service via a connected device. In this case, the billing relationship is established with the CE vendor.

In this configuration, the online video aggregator depends on several actors, from content supply to delivery to the consumer:

- Content development and rights management: content and respective rights available in VOD services are acquired through deals made with rights holders. Rights holders and aggregators have significant control over which content is licenced, the diversity of the content catalogue, and when that content can be made available on VOD services;
- Content aggregation: the online video aggregator typically filters and recommends content, providing a personalised experience. Therefore it has significant control over the diversity of content recommended to the consumer;
- Content storage and delivery: several approaches can coexist regarding this role, but normally it is controlled by one or more actors, which handle storage and caching functions. Several deals can be made directly between the online video aggregator and eyeball ISPs to prioritise traffic or cache popular content closer to the consumers;
- Service cross-device integration: this role can be taken up by the online video aggregator or an external software development firm, but is largely controlled by the conditions imposed by DRM providers (licences), OS vendors (SDKs), appstores (approval procedures) and CE vendors (closed selection of service providers or appstores' approval procedures);
- Audience management: online video aggregators typically have access to consumption data, with exception of data gathered by connected devices, which may reside with the CE vendor;
- Service provision/brokerage and billing: although online video aggregators hold a direct customer service provisioning, consumers may pay directly to online video aggregators or to CE vendors, in case they sign up to the VOD service through a connected device (smart TV, digital media player, etc.).

Figure 5.1 depicts the model described. Examples of stakeholders' names are presented next to actors' names in order to show some correspondence with real-life firms. However, it should be noted, that the use of these firms is for illustrative purposes only, and there might not be an explicit customer-supplier relationship between them.

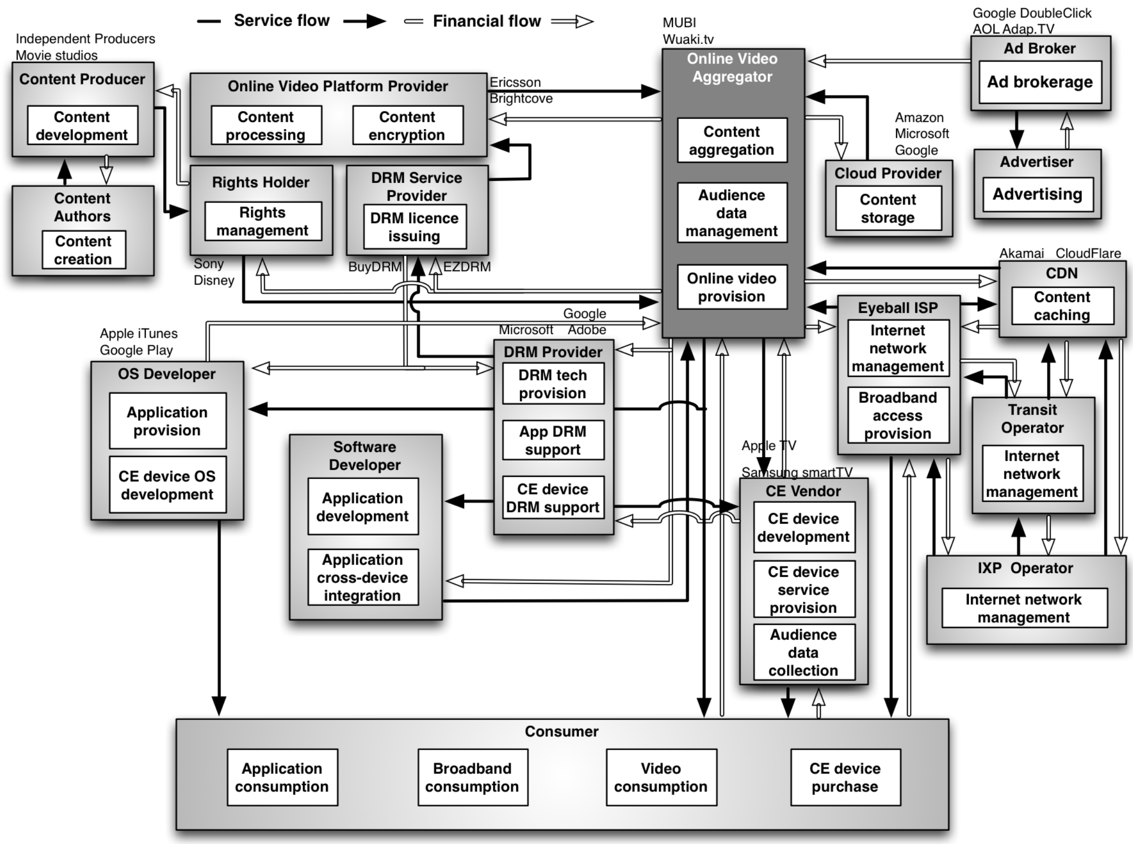


Figure 5.1: Business model configuration characterising online video aggregators' VOD services.

As previously highlighted, online video aggregators are in an unfavourable position and largely dependent on other actors. Therefore, their value proposition is mainly based on building a differentiating content catalogue and pricing model, since they are not bound to any specific content producer or film studio. For this reason, several online video aggregators are making efforts to overcome rights holders control and to differentiate their offer from other providers by securing exclusive content and by commissioning the production of new content. For example, Netflix commissioned the production of several series, such as House of Cards, and in return got exclusive rights to be the first to stream online the first two seasons. Rights for screening and streaming House of Cards were later sold to pay-TV providers and broadcasters as well (Wohlsen, 2014). Moreover, to increase its delivery capacity worldwide, Netflix built its own proprietary CDN and partners with ISPs to localise content closer to consumers via Open Connect Appliances and peering and transit agreements (Netflix, 2015a).

5.2.2 Content producers and Rights holders

In this business model configuration, services provided by content producers and rights holders, either live content or video on demand, are considered. Real-life examples include the VOD services offered by Hulu (a joint venture between NBC, FOX and Disney) and Disney, Filmin and Universciné, and the live and on demand service offered by the U.S Major League Baseball (MLB.tv).

Similarly to the previous business model configuration, consumers can access these services via a webpage, a mobile application or via a connected device. Moreover, the billing relationship may be direct with the service provider or established with a CE vendor.

In this case, these actors control more gatekeeper roles than in the previous example, in specific the roles concerned with holding content and rights and content aggregation. This business model configuration is shown in Figure 5.2.

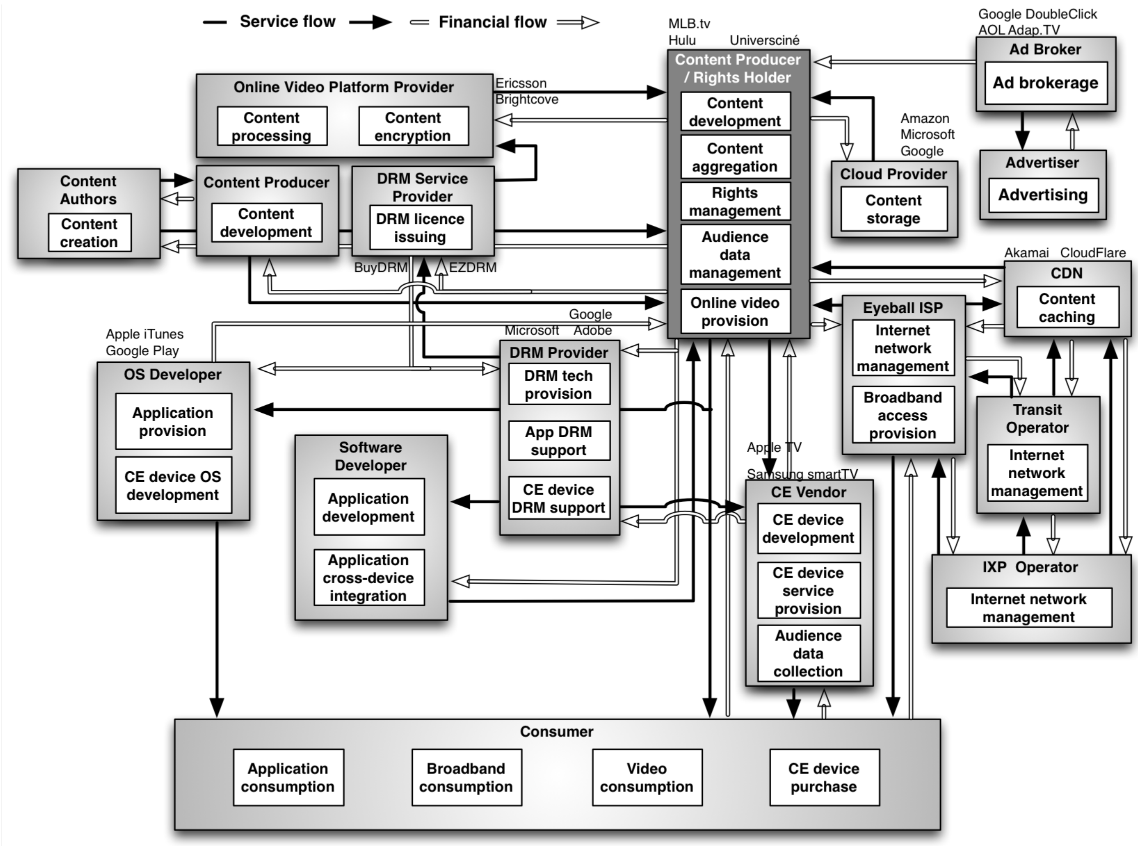


Figure 5.2: Business model configuration characterising content producers and rights holders online video services.

- Content development and rights management: these actors hold the rights to distribute the content made available on the service. Some actors also distribute content from other producers/rights holders;

- Content aggregation: these actors bundle content, but also filter and recommend content to the consumer. They are thus in a position to prioritise their own content over content licenced from other actors;

- Content storage and delivery: as in the previous model, these actors depend on other actors for storage (e.g. cloud provider) and caching (e.g. commercial CDN or ISP) functions;

- Service cross-device integration: like in the previous model, this gatekeeper role is also normally controlled by external actors (e.g. software development firms, DRM providers, OS vendors, appstores and CE vendors);

- Audience management: consumption data resides with content producers/rights holders, with exception of data gathered by connected devices, which may be controlled by the CE vendor;

- Service provision/brokerage and billing: the consumer may pay directly to the service provider or may be charged by a CE vendor, in case she signs up to the service through a connected device.

In this configuration, since these actors control their own content and rights management, they are in a position to change the rules for windowing and geo-blocking, if they wish, as well as to keep their content exclusive for their own services, thus strengthening their competitive advantage and increasing scarcity over content towards other online video service providers. However, as these actors are strongly bound to incumbent media industry organisations and their structures, which usually are characterised by small technical departments, they are likely to spend more money and effort with technological decisions and developments, and for that matter depend on third-party firms.

Hulu, because of its nature, is in a different position from the majority of real-life firms that fit into this business model configuration. Hulu not only offers content from NBC, FOX and Disney, but also from other producers and rights holders. Moreover, since 2012, Hulu has been investing in original productions and in holding exclusive rights for popular TV series (Roettgers, 2012). But

Hulu also has exclusive access to current-season primetime shows from Fox, NBC and ABC. This combined strategy of original productions and exclusive rights leads Hulu to lock-in consumers hungry for popular content and be in a position to compete with players such as Netflix. Worth also mentioning that Hulu keeps a very "traditional TV" model in what concerns advertising. Free ad-based Hulu version breaks content for two or three ads, while Hulu Plus, the subscription based version, breaks content for one or two ads (Birnbaum and Spangler, 2015).

Two other initiatives led by content producers and film studios intend to mirror the concept of physical ownership to an online digital ownership, in an attempt to promote EST sales and improve EST user experience, in detriment of the appeal that VOD subscriptions may carry. The need to strengthen EST value proposition and market stems from the need to counteract the decline of DVD and Blu-ray sales (Steirer, 2015).

The first initiative led by Disney, Disney Movies Anywhere, promotes a digital library for Disney content. Disney provides the technological platform to collect under a Disney Movies Anywhere account/app all Disney digital content acquired via different providers — iTunes store, Google Play Store and Vudu — as well as to keep digital copies of acquired DVD or Blu-ray films. Disney partnership with Google, Apple and Vudu allows Disney to keep information about its customers, although delegating the billing relationship to its partners — content can only be acquired via the partners. For consumers, the service brings in added convenience, as all the content, regardless of where it was first purchased can be watched through the Disney Movies Anywhere website or app. Moreover, the service attempts to bring down cross-platform ownership barriers as it has forced Apple and Google to list and play Disney films which were acquired on competitor's online store. Therefore, all acquired Disney films, regardless of where they were initially purchased (iTunes or Google Play) can be played through the native Google and Apple appstores, as well as the Disney Movies Anywhere app.

The second initiative, UltraViolet, a cloud-based digital rights library[8] is developed and maintained by DECE[9] since 2011, an alliance of firms, which include film studios, consumer electronics manufacturers, and vendors. Like the previous initiative, UltraViolet allows consumers to purchase

[8] Cloud-based digital rights library is the definition found in UltraViolet's website (UltraViolet, 2015), although several other definitions can be found in literature: online content locker (Pardo, 2012), digital media ecosystem (Steirer, 2015), and cloud-based digital locker (Ulin, 2014).

[9] Digital Entertainment Content Ecosystem (DECE) members include, among others, FOX, NBC Universal, Paramount, Warner Bros, Sony Pictures, Adobe, Akamai, AT&T, Cisco, BBC Worldwide, Cinema Now, Ericsson, Vudu, Wuaki.tv, Samsung, Microsoft, Widevine (Google).

content via third-party online video services partners and centrally store the licence rights for that content in an UltraViolet library, allowing consumers to later stream and download acquired content from a different service than the one where content was acquired. In addition, the consumer needs to register with each online video service provider that partners with UltraViolet to acquire content or to obtain a digital copy of DVD or Blu-ray content. Ultimately, consumers can watch content on a variety of devices supported by the online video service providers.

UltraViolet alliance, which Disney and Apple did not join, has been classified by Steirer (2015) as "an unmitigated failure" for the little traction gained among consumers, for its complicated process of registering, acquiring and streaming, hardly comparable to the one-stop experience provided by Apple or Netflix. Moreover, Steirer (2015) argues that this failure results from studios' poor understanding of their market, the difficulty in accepting the loss of sell-through revenue as irreversible, and the conviction that today's consumers still value ownership. Although launched in 2011, UltraViolet is only available in thirteen countries. Disney Movies Anywhere, launched in the beginning of 2014, despite its partnership with global online video service providers is not available in every country where iTunes and Google Play store is available. The future of these digital rights libraries is questionable and their survival will largely depend on the growth of EST sales, and user's experience and acceptance of yet another fragmented ecosystem. Will/do consumers ask themselves "Where will I store the licence rights for this film?" each time they acquire content on online video services?

5.2.3 CE Vendors

This business model configuration mainly represents the case of Sony. Sony, primarily a CE vendor, has diversified its strategy over the past two decades into music (Sony Music Entertainment) and video entertainment (Sony Pictures Entertainment and Sony Pictures Television). Sony holds two online video services: Crackle and PlayStation Vue.

Crackle is a subsidiary of Sony Pictures Entertainment and an ad-based VOD service, which features films and series from several producers and distributors, as well as Sony content. From 2012, Crackle also commissioned a number of original series and recently launched a linear, ad-supported, internet television channel (Crackle, 2015). Crackle can be accessed via the browser, mobile device and connected device.

PlayStation Vue is offered as a package of linear TV channels, as well as catch-up and on demand content, available to the consumer via subscription. However, Vue is limited to consumers that own a PlayStation gaming console (Abbruzzese, 2015).

Amongst the two services, Sony holds partial control of most gatekeeper roles:

- Content development and rights management: Sony holds the rights for Sony Pictures Entertainment content and for original programming, but also acquires content rights from other distributors. For PlayStation Vue's linear channels, Sony negotiates deals with each broadcaster/distributor for retransmission rights;
- Content aggregation: Sony aggregates and filters/recommends content to the consumer. It has significant control over the content and diversity presented to the consumer, as well as over the relevance given to Sony's content and original productions;
- Content storage and delivery: it is unclear whether Sony depends on other actors for cloud storage and content caching for these two online video services, but Sony also incorporates Sony Media Cloud Services, a subsidiary dedicated to cloud-based media utility services helping streamline content production. Therefore, one can expect that roles related to content processing, content encryption and storage are managed by Sony;
- Service cross-device integration: since Crackle is available in many mobile and connected devices, this gatekeeper role is controlled by other actors (e.g. software development firms, DRM providers, OS vendors, appstores and CE vendors), but also by Sony. Sony controls the ecosystem around its smart TVs and gaming consoles and is also active in developing open DRM standards through the Marlin Developer Community (see Section 4.3);
- Audience management: for PlayStation Vue consumption data resides with Sony, while for Crackle, data collection may be shared with other CE vendors;
- Service provision/brokerage and billing: for PlayStation Vue, Sony holds full control of service provision and billing. In the case of Crackle, this gatekeeper role is shared with other CE vendors.

The business model configuration is outlined in Figure 5.3. Sony's move to launch PlayStation Vue this year may be interpreted as a strategy to leverage on the closed ecosystem created around

Sony's gaming consoles and a consumer base that is pleased with consuming content via these devices. In 2013, Netflix CEO Reed Hastings reported that Sony's PS3 was the most used connected device to stream Netflix content (Gaudiosi, 2013), reinforcing that Sony has a large customer base. In this model, the relationship between hardware and services is strengthened, without the intermediation of pay-TV operators. Whether Vue (and other CE vendors services that may arise) will succeeded as a service will strongly depend on PlayStation's customer base and Vue's available content (in this case mainly TV channels) needs to be compelling and differentiating enough to ensure consumer uptake, but also to ensure interest from broadcasters to be present in the service and share revenue with Sony.

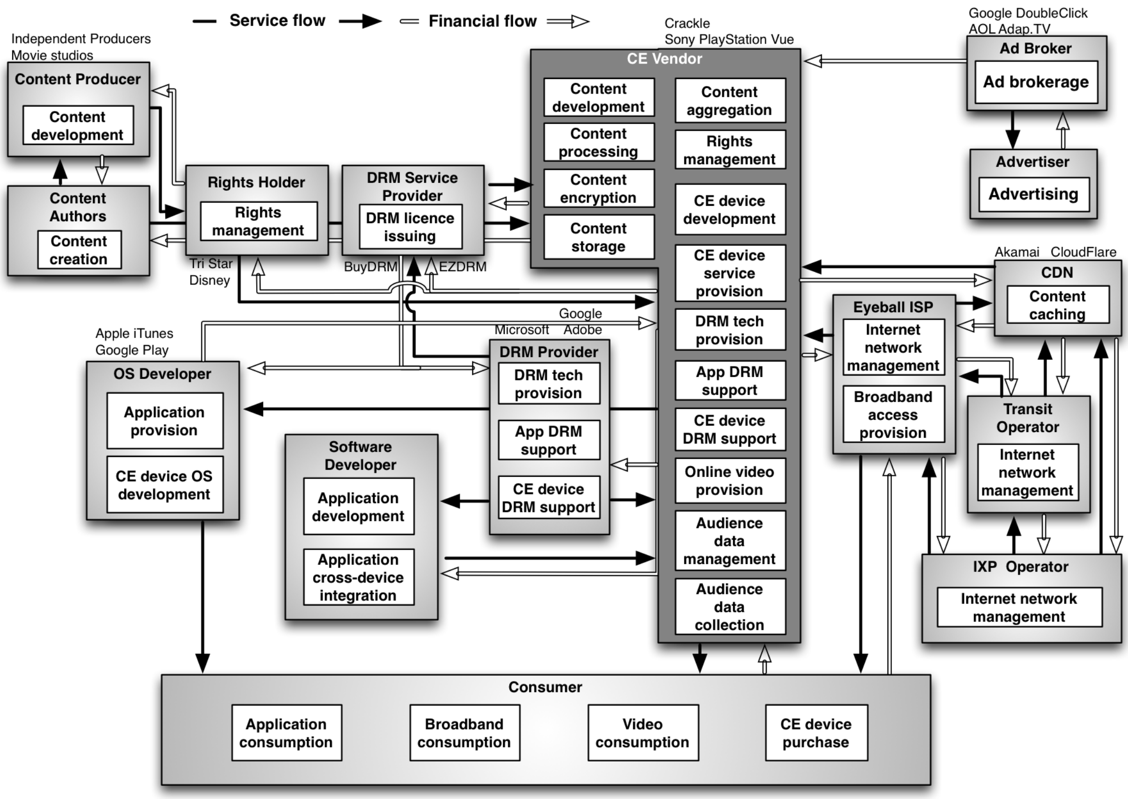


Figure 5.3: Business model configuration characterising Sony's online video services.

5.2.4 Internet Players

In this section, the focus is on online video services provided by Amazon, Google, Apple, and Microsoft — respectively, Amazon (Prime) Instant Video, Google Play Movies & TV Store and YouTube Movies, iTunes Store, and Microsoft Movies & TV[10]. All these players provide complementary and related services which contribute to building an integrated strategy with tight coupling between hardware, software and services.

Although all these services can be accessed via the browser, there are certain limitations for mobile devices and connected devices. For instance, the iTunes Store app is not available in mobile devices running Google's Android or Microsoft's Windows operating systems, and the same applies to Google Play Store and Windows Store apps not being available in competing operating systems. However, the Amazon Shopping app which gives access to Amazon's Instant Video is available for download for Amazon's Fire OS mobile devices, and for Apple, Microsoft and Android-based mobile devices.

With regards to connected devices, iTunes is only available on Apple TV, while Microsoft Movies is only available on the Xbox. For connected devices, Google has built a strategy similar to mobile devices. Google launched Android TV, a kind of operating system for connected devices that CE vendors (e.g. Sharp, Sony) can licence for the connected devices they develop. In addition, Google opened Android TV to developers offering developing tools, reference guides and a marketplace. Therefore Google Play Store does now include a section with Android TV apps and Google Play Movies is integrated in all devices running Android TV. Google also created its own line of connected devices — Nexus Player. Amazon did not open its Fire OS (actually based on Android OS) to CE vendors, but partnered with them (e.g. LG, Panasonic, TiVo, Roku) to have its Amazon Shopping app integrated on connected devices. In addition, Amazon also developed its own digital media players — Amazon Fire TV and Fire TV Stick.

In this business model configuration, gatekeeper roles are even more concentrated in the online video service provider, i.e. Internet player, than in the previous model:

- Content development and rights management: all four stakeholders depend on rights holders and distributors deals to provide content on their services. All stakeholders have announced several deals to secure exclusive rights to offer certain TV series. In addition, Amazon and Google have also moved into financing original programming. Amazon through Amazon Studios is financing new productions — on its website, creators can upload ideas and concept videos, Amazon users may contribute to select the best ideas, and Amazon will fund, produce,

[10] Formerly Xbox Video.

and distribute the winning ideas on Instant Video — resembling crowdsourcing campaigns. YouTube Original Channel Initiative launched in 2012 has also supported the production of more than 160 original channels and similar plans were announced for 2015;

- Content aggregation: All stakeholders have control over aggregation, typically filtering and recommending content, and controlling the diversity of the content offered on the service;

- Content storage and delivery: Google Cloud Platform, Microsoft Azure and Amazon AWS are commercial storage and cloud computing solutions which can be used by firms to streamline their operations online, but one can expect Google, Microsoft and Amazon's online video services to benefit from these services. Apple owns iCloud, a cloud storage service, which only serves Apple customers with an Apple ID and to be used to backup customers' data on Apple's applications (Mail, iTunes, Calendar, etc.) and files created on Apple devices. All four players are known for having built their own private network infrastructure and CDNs to improve content delivery and not depend on other stakeholders. So it appears that all four stakeholders control this gatekeeper role, although this may be just partially as they still need to interconnect with ISPs to reach the consumer;

- Service cross-device integration: all stakeholders control most of this gatekeeper role. These Internet players have developed operating systems and related appstores, are providers of DRM (Google, Microsoft, Apple) and streaming (Apple and Microsoft) technologies and have developed connected devices (Apple TV, Google Nexus Player, Microsoft Xbox and Amazon Fire TV and Fire TV Stick) and respective operating systems. Only Amazon seems to be in a weaker position compared to others, in the sense of agreeing to the terms of appstores, using competing SDKs, etc.. Amazon Instant Video is not tied to Amazon devices and OS only, since Amazon pursued a strategy of integration with Apple OS and Android OS mobile devices, Microsoft Xbox and a long list of other gaming consoles, media players and smart TVs;

- Audience management: all four stakeholders hold full control of consumption data, except for Amazon, in which data collection may be intermediated by a CE Vendor;

- Service provision/brokerage and billing: All stakeholders hold control of service provision and billing for the indicated services when these are used in personal computers and mobile devices. In mobile devices running Android OS, Google still holds the billing relationship and not the CE vendor. As Amazon Instant Video is available in non-Amazon controlled devices, billing is controlled by CE vendors when the user registers for the service via the device. In addition, as all four players have developed proprietary and closed connected devices, they may also hold control of the billing relationship for the applications/services (Netflix, Hulu, Sling, MLB.TV, etc.) made available on these devices.

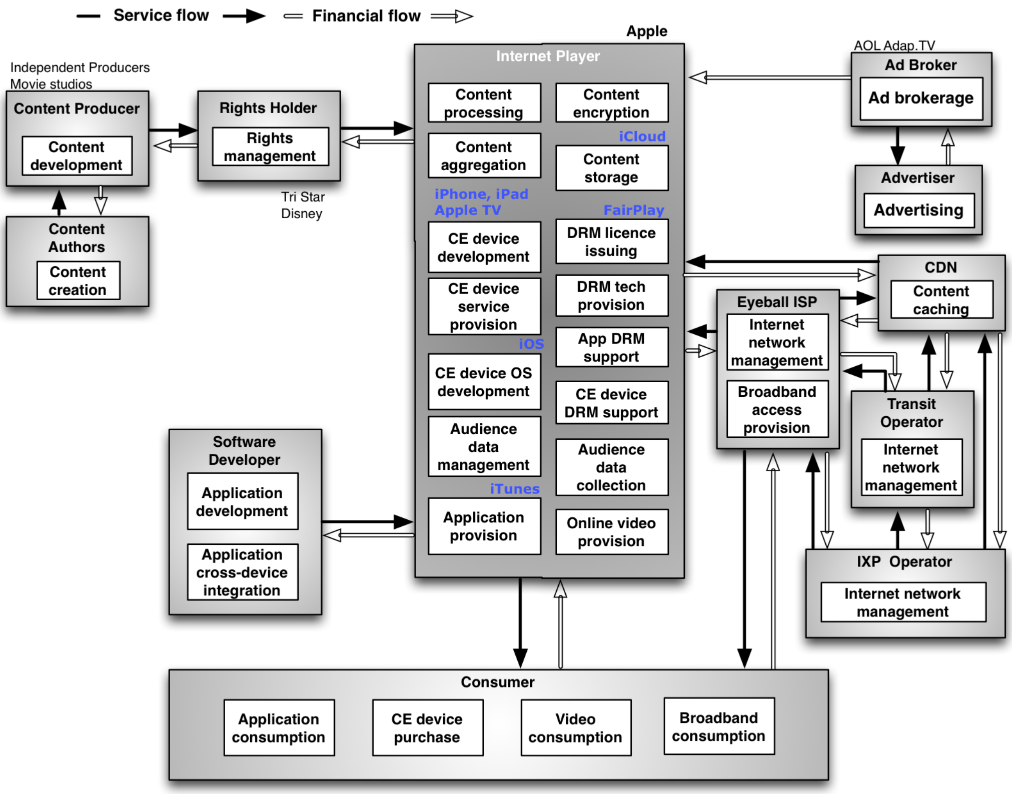


Figure 5.4: Business model configuration characterising Apple's online video services.

The configuration for Apple in shown in Figure 5.4. Apple, like the other Internet players here analysed, leverages on its strong brand and the tight coupling between hardware, software and service to lock-in customers and achieve competitive advantage. Players do not yield up the control of customer ownership and billing relationship, except Amazon, which appears to have favoured a dual strategy — on the one hand, a tight integration between hardware, software and service, and on the other hand, disseminating the service application in many CE devices controlled by other

CE vendors. In addition, Amazon packaged the video subscription model in a yearly-subscription offering other services, demonstrating Amazon's intention to quickly enter the market and build a large customer base.

With regards to connected devices, all stakeholders seem to keep quite tight control on which applications can be placed on the device, except for Apple and Google. Apple offers developers the possibility to publish their apps to Apple TV store, with a similar submission procedure of apps for mobile devices. Google opened up Android TV to developers and offers an appstore, similarly to Android OS for mobile devices. But there is one difference in the relationship with CE vendors, which underlines Google taking more control of this new platform: with Android OS, CE vendors are allowed to brand and customise the operating system, which has lead to the device fragmentation already mentioned; with Android TV, vendors are allowed to pre-install some applications and build a remote control, but are not allowed to customise the OS or the user interface. Therefore, developed applications are expected to have the same behaviour across all Android TV-based devices.

5.2.5 Pay-TV operators

Pay-TV operators are involved in three different types of online video services — TV Everywhere, live and catch-up linear TV, and VOD —, presenting however many similarities for each gatekeeper role. Consumers can access these services via a Web browser or a mobile application. With the exception of TV Everywhere, services can also be accessed via a connected device.

As many pay-TV operators are also broadband providers and ISPs, pay-TV operators have evident control over content storage and Internet delivery. As for the remaining roles, pay-TV operators share the control with other actors. The business model configuration is depicted in Figure 5.5.

- Content development and rights management: pay-TV operators need to licence all content that is distributed over their services, therefore this role is controlled by producers, rights holders and broadcasters;
- Content aggregation: since pay-TV operators decide about and pre-select TV channels that are available on TV Everywhere and online linear TV services, they determine the content

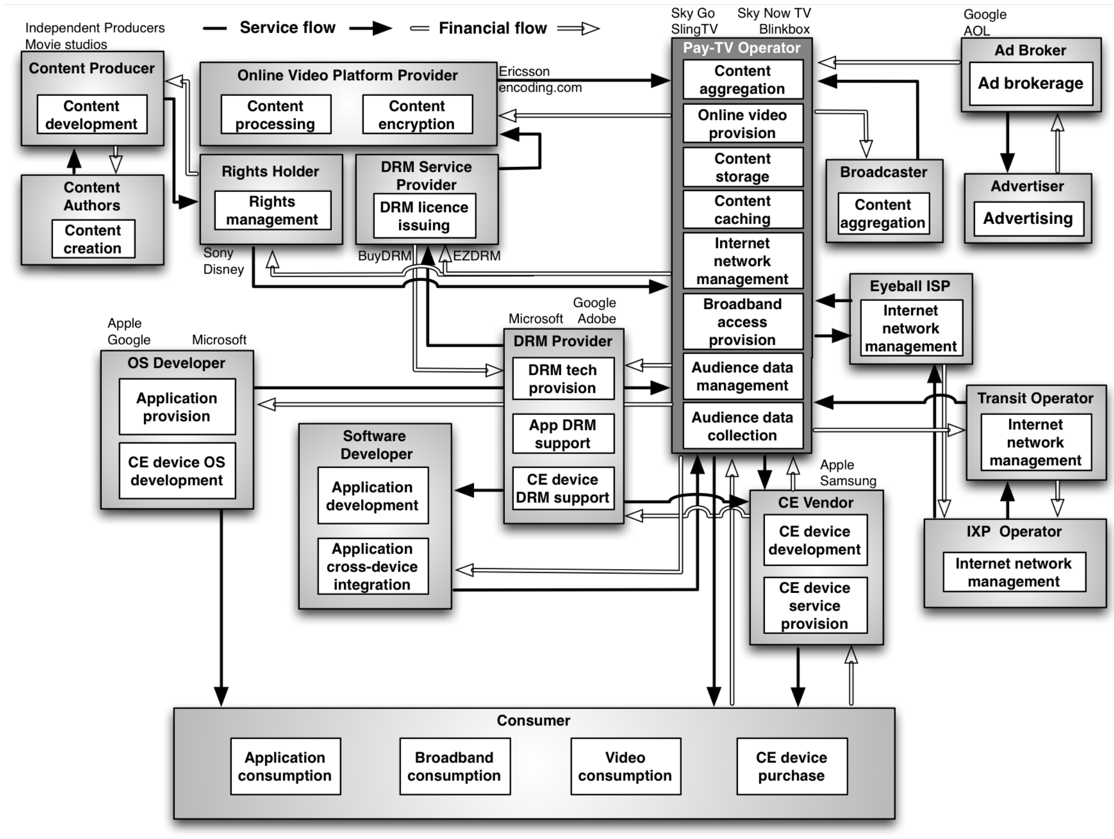


Figure 5.5: Business model configuration characterising pay-TV operators online video services.

that will be available to consumers. The same occurs for VOD services, with additional filtering and recommendation features which may lead consumers to consume certain content in detriment of others;

- Content storage and delivery: although these services are provided over the open Internet, one can assume that most pay-TV operators hold storage facilities and are in a position to establish peering and transit agreements with other ISPs and transit operators, thus being in an advantageous position compared to other online video service providers;

- Service cross-device integration: this gatekeeper role is normally controlled by other actors (e.g. software development firms, DRM providers, OS vendors, appstores and CE vendors) as most of pay-TV operators services are available on mobile and connected devices;

- Audience management: consumer and audience data mostly resides with pay-TV operators, except when CE vendors hold a brokering role in service provision and billing;

- Service provision/brokerage and billing: although for TV Everywhere services, pay-TV operators control provisioning and billing, with respect to VOD and linear TV services, a brokering role may be played by CE vendors.

This business model configuration assumes that all software development for web portals, mobile apps and connected devices apps is outsourced by pay-TV operators. Nevertheless many pay-TV operators have dedicated departments for software development and most apps are developed in-house. In addition, pay-TV operators may also partner with CDN providers and IXP operators to take their content closer to the consumer.

TV Everywhere services can be regarded as a defensive move of pay-TV operators towards the threat of cord-cutting and consumers fleeing to Internet VOD services. TV Everywhere services represent low risk and low investment for pay-TV providers, while delivering added value to users which already hold a subscription and strengthening competitive advantage. Finally, these services may render additional revenues from advertising, as streams contain the same ads as in the original linear broadcasts.

Worth also mentioning Sky's strategy behind *à la carte* Sky Now TV. The service is offered in three modalities — three monthly passes of films, entertainment (13 linear TV channels) and sports (8 Sky Sports linear TV channels). Consumers can access the service and watch content on the computer, mobile device and selected list of connected devices (Apple TV, Xbox, PlayStation, etc.). Sky also offers a box for a one-time payment of £9.99, similar to a digital media player, which allows the consumer to stream Sky Now TV content to a TV-set, access to catch-up content and to other apps such as BBC iPlayer, MLB.tv, Spotify. With this box, Sky is not only mimicking the walled garden of the set-top box in a pay-TV package, but is also assuring control of audience data. In addition, by incorporating third-party apps in the box, Sky becomes the broker for the billing relationship for the apps that require registration and holds consumption data for the content watched over those services.

5.2.6 Broadcasters

Broadcasters in transition to an online experience mainly offer linear TV and catch-up of the most recent aired programs. Many services offer content on an open and free basis, i.e. no sign-up or login are required (e.g. RTP Play, France 24), although in some services, a personalised experience is also offered requiring user's registration (e.g. BBC iPlayer). Commercial broadcasters, such as CBS, offer access to live TV, catch-up and on demand content via a subscription.

Premium channels such as HBO offer live and catch-up access to its content, but require authentication via a pay-TV provider, since HBO is bundled in pay-TV packages.

VOD services offered by HBO and Canal+, respectively, HBO Now and CanalPlay, offer unlimited access to VOD content, films and series, from a wide range of distributors and rights holders. These services are available on a subscription basis via the computer, mobile device and connected device. The consumer does not subscribe directly with HBO or Canal+, but via a third-party provider, an Internet Player (Apple, Google, Amazon), a broadband provider or a pay-TV provider.

This business model configuration for online video services provided by broadcasters is shown in Figure 5.6.

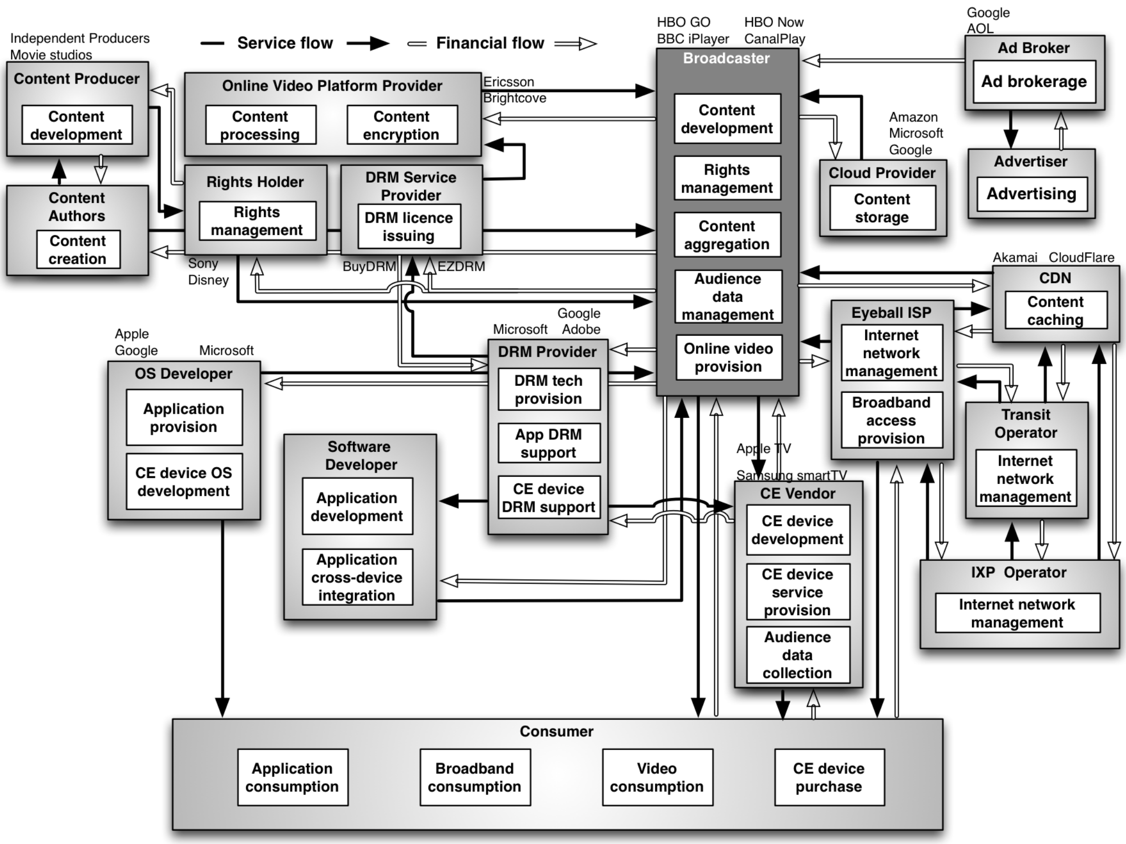


Figure 5.6: Business model configuration characterising broadcasters online video services.

- Content development and rights management: content on these services may be produced by broadcasters or acquired from other producers and rights holders. This role is essentially controlled by other actors;

- Content aggregation: broadcasters pre-select content and also decide on the content made available on linear TV, although certain restrictions may be imposed by national (and european) regulation. Like in other VOD services, the personalised interface and recommendations may influence the content that is consumed;
- Content storage and delivery: broadcasters may depend on other actors for storage (e.g. cloud provider) and caching (e.g. commercial CDN or ISP) functions. However, as noted by two interviewees, several options can be considered and these will be explored below;
- Service cross-device integration: this gatekeeper role is also controlled by other actors (e.g. software development firms, DRM providers, OS vendors, appstores and CE vendors) as most broadcasters services are available on mobile and connected devices. Some broadcasters may however have internal software development departments;
- Audience management: audience data mostly resides with broadcasters, with exception of data gathered by connected devices, which may reside with the CE vendor holding a brokering role in service provision;
- Service provision/brokerage and billing: service provision is direct or intermediated by a CE vendor. The consumer may pay directly to the broadcaster or needs to subscribe to the service via a 3rd party provider, which handles all the billing consumer data.

As noted previously, two interviewees highlighted the additional costs and the different options to deliver broadcasters' online video services over the Internet (note that live video may not require additional storage, but catch-up content certainly does). The different options detailed below can in practice be used by other types of actors, such as online video aggregators, content producers, distributors or rights holders. To deliver content over the Internet, two factors are important: (1) content storage facilities are fundamental for catch-up and on demand content, and (2) once a service achieves a certain scale and consumer base, caching content closer to the consumer becomes relevant in order to meet consumer's quality of experience expectations and to reduce persistent buffering experiences.

The configurations depicted in Figure 5.7 show under which actor's domain can storage and caching functions be placed. Nowadays, CDNs and transit operators may also offer additional services, such as conditional access, geo-restricted delivery and DRM, which are relevant for an online video service provider wanting to deliver video on an international basis. Note that, for the sake of simplicity, it is considered here that traffic flows between eyeball ISPs and IXPs through transit operators, although what was stated at the beginning of this section still holds — eyeball ISPs may interconnect directly via an IXP and traffic may not be routed via a transit operator. Moreover, an increasing number of broadcasters (and generically, online video service providers) also interconnect directly with eyeball ISPs via an IXP. The following configurations also demonstrate the increasing importance of CDNs in delivering content and how several actors want to play a role as CDN providers as well. Several stakeholders' business strategies over the past years substantiate that eyeball ISPs and transit operators have vertically integrated CDN functions.

In essence, these configurations also intend to highlight the complexity of delivering video services over the Internet, especially for stakeholders which do not hold the competencies to compare and choose one configuration over another. As highlighted by one respondent, delivering video services over the Internet is a learning process and different configurations may be adopted as services gain more prominence, an increasing customer base and a larger content catalogue.

I Content is stored within the service provider's premises and caching of popular content takes place at a commercial CDN, such as Akamai or Limelight;

II Content is cached within the service provider's premises and caching takes place at an eyeball ISP;

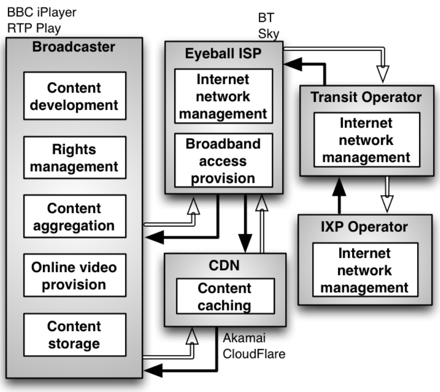
III Both storage and caching functions are handled at the facilities of an eyeball ISP;

IV Both storage and caching functions are handled at the facilities of a tier-1 ISP, such as Level 3;

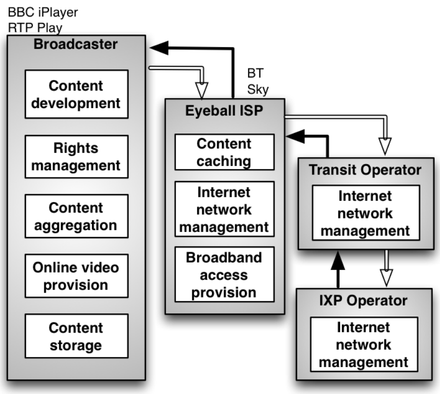
V Content is stored at a cloud service provider (e.g. Amazon AWS, Microsoft Azure) and caching is handled by an eyeball ISP;

VI The online video service provider interconnects directly with eyeball ISPs via an IXP and content does not need to be cached elsewhere. If content is stored in-house, a link to the Internet is always needed;

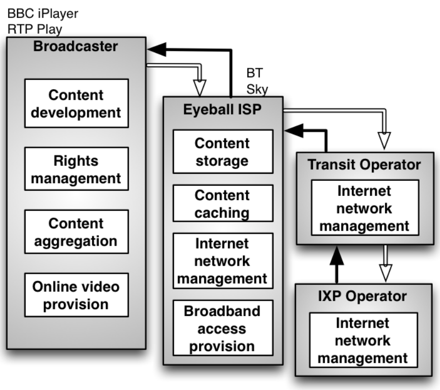
VII Content is stored at a cloud service provider and caching of popular content takes place at a commercial CDN (this configuration is represented in Figure 5.6).



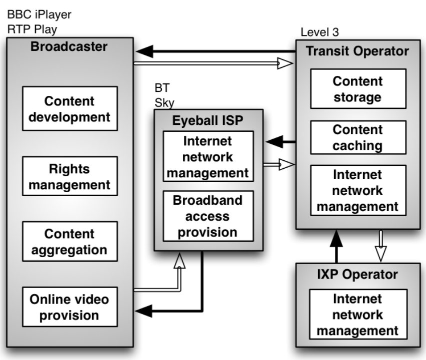
(a) (I)



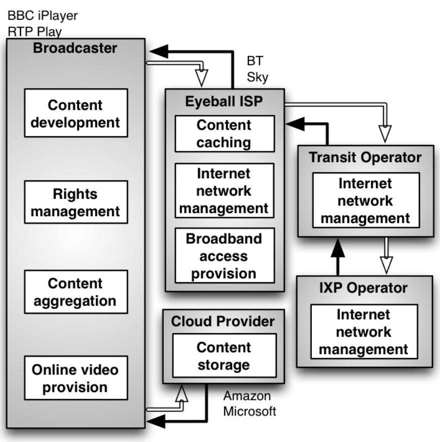
(b) (II)



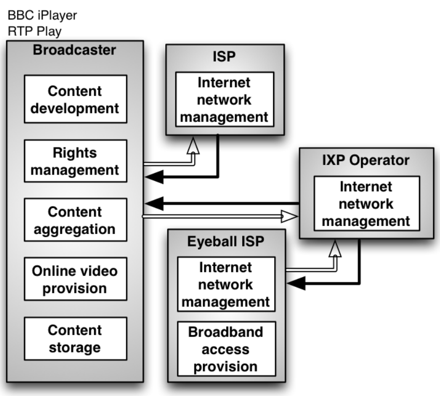
(c) (III)



(d) (IV)



(e) (V)



(f) (VI)

Figure 5.7: Different business model configurations for storing and caching video assets for Internet delivery.

5.2.7 Summary of business model configurations

In this section, business model configurations for six types of actors providing online video services were outlined. These configurations constitute different representations in which each of the six types of actors controls a number of crucial gatekeeper roles. Six gatekeeper roles represent the aggregation of the control points discussed in the previous section around crucial functions, which add value or originate control in online video services. Table 5.2 summarises the owners of the gatekeeper roles in the different online video services provided by the identified actors. As can be seen in the table, the gatekeeper roles of content development and content delivery are still controlled by the traditional gatekeepers of the media and telecommunications industries, respectively. There are only a few examples of stakeholders which decided to take hold of these functions and moved into those domains, employing strategies of merger and acquisitions or scaling up their businesses. The other gatekeeping roles seem easier to take hold of, since several actors have been able to introduce those gatekeeping functions in their businesses.

Table 5.2: Owners of the gatekeeper roles in different online video services provided by the identified actors.

	Business Model Configurations					
Gatekeeper roles	Online Video Aggregators	Content Producers and Rights Holders	CE Vendors	Internet Players	Pay-TV operators	Broadcasters
Content development and rights management	• Rights Holders • Distributors	• Content Producers • Rights Holders	• Rights Holders • Distributors • Broadcasters • CE Vendors	• Rights Holders • Distributors • Internet Players	• Rights Holders • Distributors • Broadcasters	• Rights Holders • Distributors • Broadcasters
Content aggregation	• Online Video Aggregators	• Content Producers • Rights Holders	• CE Vendors	• Internet Players	• Pay-TV operators	• Broadcasters
Content storage and delivery	• Cloud providers • CDNs • ISPs	• Cloud providers • CDNs • ISPs	• CE Vendors • CDNs • ISPs	• Internet Players • ISPs	• Pay-TV operators	• Cloud providers • CDNs • ISPs
Service cross-device integration	• Software developers • DRM providers • OS vendors • Appstores • CE vendors • Online Video Aggregators	• Software developers • DRM providers • OS vendors • Appstores • CE vendors	• Software developers • DRM providers • OS vendors • Appstores • CE vendors	• Internet Players • CE vendors	• Software developers • DRM providers • OS vendors • Appstores • CE vendors • Pay-TV operators	• Software developers • DRM providers • OS vendors • Appstores • CE vendors • Broadcasters
Service provisioning/ brokerage and billing	• Online Video Aggregators • CE Vendors	• Content Producers • Rights Holders • CE Vendors	• CE vendors	• Internet Players • CE vendors	• Pay-TV operators • CE vendors	• Broadcasters • Pay-TV operators • Internet Players
Audience management	• Online Video Aggregators • CE Vendors	• Content Producers • Rights Holders • CE Vendors	• CE vendors	• Internet Players • CE vendors	• Pay-TV operators • CE vendors	• Broadcasters • CE Vendors

The configurations presented and the real-life examples associated demonstrate that all different types of actors are making vibrant efforts to take hold of a share of online video business aspirations.

As depicted in Figure 5.8, several actors are shifting their activities to other value streams, while incorporating new gatekeeping roles.

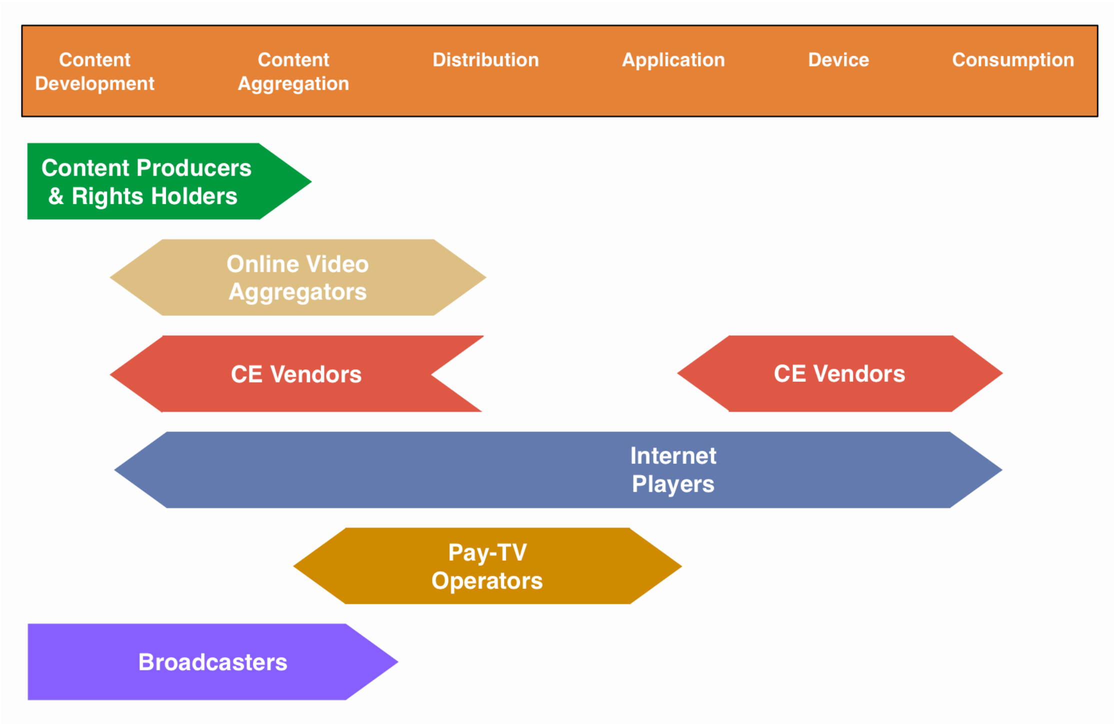


Figure 5.8: Actors expanding their activities from their 'traditional' value streams to other value streams.

Although the derived business model configurations do not reveal which models will thrive, they show that certain actors are better positioned than others to succeed since, on the one hand, they are in control of crucial assets for service provision, and on the other hand, they control the customer relationship, either through previously established business relationships or through tight coupling with other services and hardware.

Online video aggregators face high barriers to entry and are largely dependent on other actors for service provision. Their value proposition is mainly based on building a differentiating content catalogue and pricing model. An exception to this, Netflix, has been able to gather the necessary financing to also control functions of content production and Internet delivery.

Content producers and distributors are still largely attached to incumbent media industry practices and are enforcing those practices towards other actors. They control the most critical resource, content, and are in a position to influence how other actors have access to it. In addition, to compensate for losses in other distribution channels, distributors are linking physical media ownership to online digital ownership, in order to attract more consumers to online services.

Pay-TV providers and broadcasters' online strategies are mostly motivated by the threat of cord-cutting. Holding a strong brand and a large established customer base may render them the necessary control points to succeed in building verticalised strategies of bundling online video services with commoditised services such as TV, telephone or Internet access.

CE vendors and Internet players are leveraging on previous business relationships established with consumers, typically in closed ecosystems created around devices, software and other services. Their strong brands and walled gardens ensure the necessary control points to lock-in customers and achieve competitive advantage over other actors. They lack, however, control over content. But their financial dimension has allowed several of these players to quickly enter in the realms of content production as well. Furthermore, CE vendors and online video service providers can benefit from partnering with each other, as the first need services in order to develop compelling devices, and for the second, these partnerships represent opportunities to increase the customer base and strengthen their market position. Netflix is one of the most active players in partnering with CE vendors, as it shows its partnerships with TV, Blu-ray and set-top box makers. Netflix buttons have been incorporated in many devices' remote controls, blending the online video and TV experience, and giving Netflix a first-mover advantage.

As the examples discussed show, in an attempt to control a share of the online video market revenues, several players are experimenting with different business models. This implies they are delivering more than one online video service, yet sometimes cannibalising each other, with different content catalogues, pricing strategies and differing targeted consumers. It seems obvious that at some point in time it will become unfeasible to maintain so many different services and these will tend to converge to a few dominant business models.

The examples also indicate that service provision does not necessarily mean customer ownership. Devices are playing a prominent role in the intermediation with the consumer and, in particular conditions, are allowing CE vendors to control the billing relationship and consequently the revenue sharing with online video service providers. Vendors are also mimicking the two-sided market strategies of the mobile industry in the development of new connected devices — on one side, the relationship with online video service providers just explained, and on the other side, devices' technical platforms opened to application developers. Android TV, Apple TV and Samsung Apps

TV[11] offer developers the tools for app development and the marketplace to sell those apps, with a revenue split of 70% for developers and 30% for Google and Samsung.

5.3 Conclusion

This chapter addressed the second and third steps of the adopted methodology. The first section outlined and discussed the control points raised by respondents in in-depth interviews. The control points were grouped and presented by business stream — Content, Distribution, Application, Device, and Consumption — and the discussion took in consideration control points properties — interchangeability, demand, value, and time — and the way control points contribute to value network and functional architecture parameters.

In the content stream, rights holders, sales agents, distributors, stand out as exercising control over the most valuable asset, i.e. content, for online video service providers. This positioning gives them the power to establish the "business rules", create scarcity effects, influence competition between online video service providers and create entry barriers for small players. It indirectly affects how content reaches consumers, potentially having been subject to selection and filtering. But the maturity and growth of online video services is expected to put pressure on the terms and conditions imposed by content and rights owners.

As for Internet distribution, most respondents acknowledge the differences in costs and procedures when compared to other media distribution channels. Several respondents see CDN providers as key actors in controlling the necessary resources for Internet distribution, while other interviewees recognise that beyond CDNs, eyeball ISPs are in fact controlling the direct relationship with consumers and with transit operators, thus being in a key position to shape traffic management and compete in online video services. Mobile operators are regarded as restraining the business case for high quality video delivery, essentially for two reasons: mobile networks cannot yet cope with an increase in traffic demand, and operators have created artificial measures, e.g. data caps and expensive data plans, to curb online video consumption.

Although the control points in the application stream are essentially of technical nature, they seem to limit the value of online video services and create additional R&D efforts and investments for online video service providers. By creating constraints on the availability of services on multiple

[11] See http://seller.samsungapps.com/tv/portal/main

operating systems and devices, these control points also impact services' adoption rate and user experience. In addition, the technical burdens and associated costs also appear to create entry barriers for small online video service players.

In the device stream, CE vendors and OS vendors are regarded as the main sources of control given the fragmentation of OS versions and the uncertainty over the future adoption of streaming and DRM technologies. The emergence and diffusion of connected devices also reveals the creation of new walled gardens, since CE vendors are positioning these devices as a source of audience data and a source of revenue from online video services. CE vendors are also becoming the gatekeepers of the applications bundled on the devices and the billing relationship established with consumers.

In the consumption stream, power lies with the actor(s) who own a direct customer relationship and/or who own an established customer base. A direct customer relationship gives an actor leverage to monetise audience information and viewers' preferences, while establishing an additional source of revenue. An actor with an established customer base has the strategic advantage to upsell online video services and experiment with consumer bundles, in order to raise online video services' adoption.

Most control points identified are of technical or business nature, and less emphasis was put on regulatory control points. It can be argued that as online video services are still at an early stage of development, organisations are reconfiguring themselves and adapting, the market is still very much self-regulated and regulation plays little influence in the daily market dynamics.

The second section enumerated a number of business model configurations centred on the actor holding service provision. Analysis was focused on which actors were controlling a number of crucial gatekeeper roles. These gatekeeper roles were discerned on the basis of the control points related to the value streams previously identified and were grouped around functions which were highlighted as susceptible for exercising control, filtering content, or giving competitive advantage, but that could also add value. Six gatekeeper roles were identified: Content development and rights management, Content aggregation, Content storage and delivery, Service cross-device integration, Audience Management, and Service provision/brokerage and billing.

The configurations presented and the real-life examples associated demonstrated that all different types of actors are making vibrant efforts to take hold of a share of online video business aspirations. Although the configurations do not reveal which models will thrive, they show that certain actors are better positioned than others to succeed since, on the one hand, they are in control of crucial assets for service provision, and on the other hand, they control the customer relationship, either through previously established business relationships or through tight coupling with other services and hardware.

The examples analysed also showed that service provision does not necessarily mean customer ownership. Devices are playing a prominent role in the intermediation with the consumer and, in particular conditions, are allowing CE vendors to control the billing relationship and consequently the revenue sharing with online video service providers. Vendors are also mimicking the two-sided market strategies of the mobile industry in the development of new connected devices — on one side, the relationship with online video service providers just explained, and on the other side, devices' technical platforms opened to application developers. Furthermore, in an attempt to control a share of the online video market revenues, several players are experimenting with different business models. This implies they are delivering more than one online video service, yet sometimes cannibalising each other, with different content catalogues, pricing strategies and differing targeting consumers. It seems obvious that at some point in time it will become unfeasible to maintain so many different services and these will tend to converge to a few dominant business models.

This chapter completed an important part of the research objectives of this thesis by further characterising the current state of online video services, providing an exhaustive overview and discussion of relevant real-life services, and identifying where are currently standing the power and control positions in the value network.

The following chapter will address Future Internet and Future Media research and standardisation developments.

Chapter 6

Future Internet and Future Media

The Internet evolved from a limited communication system between a restricted number of mainframes operated by military and research communities to one of the most important drivers of innovation and competitiveness operated by commercial players who, at the end of the day, need to make profit. Launched and funded by the U.S. government in 1972, the ARPANET, and later the NSFNET, grew to more than 22 000 international interconnected networks at the time it was 'privatised'. Following a decision in 1991 to allow commercial use of the Internet, the NSFNET was 'transferred' in 1995 from public domain (from the U.S. National Science Foundation) to private service providers (Abbate, 2000). Throughout this process and in subsequent years, new institutional practices and a number of institutions (ICANN, RIPE, IETF, etc.) emerged to assure many of Internet's critical technical functions (e.g. interconnection, interoperability, capacity management and system management (Lemstra, 2008)).

With several business and technological bottlenecks being experienced in the current ecosystem, various research and standardisation efforts have begun to ponder over how the Internet of the future should look like. However, there are several views on how to make the Internet move forward to the so called Future Internet. On the one side, many believe that current Internet's challenges can only be solved through rethinking the fundamental goals and design principles underlying its architecture through a clean-slate approach (Talbot, 2005; Feldmann, 2007). On the other side, evolutionary research posits that Internet's original architecture has already shown the capability to adapt to new services and applications and therefore the same approach of solving problems as they emerge should continue to be pursued, provided that backward compatibility and incremental deployment is ensured (Rexford and Dovrolis, 2010; Dovrolis, 2008).

However, it is crucial to consider that the Internet of the future will not merely solve technical problems, but rather tackle a number of multidisciplinary issues. This seems to be the perspective of the two independently developed visions for the Future Internet put forward by ITU-T and ISO/IEC, encompassing not only technical goals but also social and economic concerns. It is envisaged that the Future Internet will eventually provide the means to develop new user centric services, with superior quality and flexibility, in a trusted and personalised context, improving citizens' quality of life, working conditions, edutainment and safety. Other factors of concern include Internet's universal access and social and economic sustainability of future networks. Both organisations have set 2015-2020 as the target dates to have standards in place and technology ready to be widely deployed, while considering that evolution and migration strategies may be employed to accommodate emerging and future network technologies.

Along the perspective of Future Internet and reflecting upon content consumption, a specific line of research has emerged dedicated to Future Media and Future Content Centric Internet. New ways of media creation and consumption, new content types, new multimedia and immersive experiences will make part of user demand for professional and user-generated media-based services in the future. Therefore, FI should enable the next generation of media and personalised content services, catering for efficient handling, delivery, presentation and protection of content. Among other factors, for the transmission of media content, it is important that the network layer guarantees that transmission delays will not surpass certain thresholds, so that user experience is not hampered. High bandwidth, real-time, low delay transmission in the Future Internet will become crucial for media content. Future Media is then FI's perspective on delivery, in-the-network adaptation, and consumption of media over the FI ecosystem (FMI-TF, 2011).

The summary of Future Network (FN) research and standardisation activities (Figure 6.1) gathered by Matsubara et al. (2013) shows the great momentum around the world in research and development of Future Internet technologies, such as network virtualisation, software defined networks, information centric networking, cloud networking, autonomic management, and open connectivity.

The main objectives of this chapter are to report on the advancements of Future Internet and

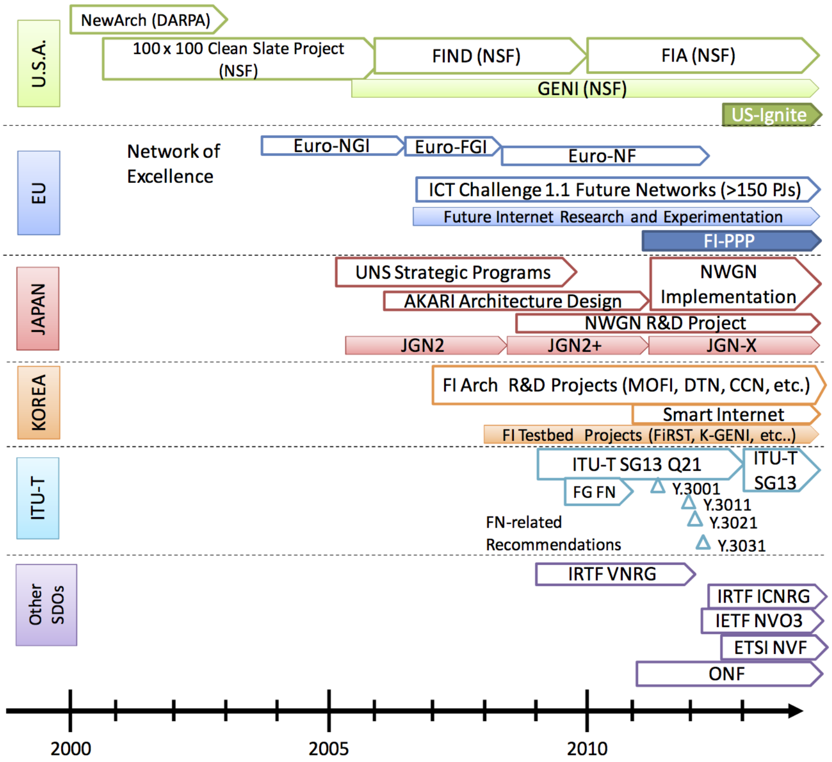


Figure 6.1: Timeline of Future Internet research programs and standardisation activities (ISO/IEC standardisation activities are not depicted) (Matsubara et al., 2013).

Future Media, identify potential technological triggers which may impact online video services, and answer the first research question of this study. Hence, this chapter firstly reviews the original Internet architecture with special focus on its original goals and principles. Understanding its original design principles provides a context to study the requirements and design goals for the Future Internet. In addition, the limitations of the current Internet technology are outlined and the approaches and research programmes being considered for the evolution of the architecture are described in the second section. The third section provides an overview of the standardisation activities related with Future Internet or Future Network and media and data related standards being addressed by ITU-T and ISO/IEC. In specific, the objectives, design goals and requirements are underlined. The fourth section presents and discusses three initiatives developed within the European research agenda addressing content-centric networking for the purpose of handling media content. Finally, conclusions are provided together with the answer to:

(RQ1) How are the technical requirements of the media business stakeholders being accommodated by FI design and standardisation activities?

6.1 The Current Internet and its Limitations

The early history of the Internet reports to a military context which eventually influenced its design as a reflection of the military requirements and priorities of the time. Survivability and reliability can be highlighted as the main first requirements of the Internet and these highly shaped what were later identified as the Internet's design goals and principles and consequently protocol implementations.

Only in 1988 and much later than the first protocol implementations were proposed, Clark (1988) captured under one top level goal and seven ordered second level goals the reasoning behind the original Internet's architecture and the protocols that had been developed so far. Clark identified as the top level goal for the DARPA[1] Internet architecture the development of an effective technique for multiplexed interconnection of the ARPANET[2] to other networks. The interconnection of existing networks was required since it did not seem feasible to re-engineer or change existing network technologies to accommodate for that feature. The technique selected for multiplexing was initially[3] advanced by Baran (1977) in the early 1960's and consisted of packet switching, which splits up all data into packets that are transmitted independently over the network and reassembled at their destination. In contrast with the prevailing paradigm of circuit switching, this technique would meet well the need for survivability and extreme reliability of communications in a military network. These survivability and reliability requirements were translated by Clark in the remaining second order architectural goals. Table 6.1 summarises the ordered list of Internet's second level design goals.

One could claim that if the goals identified by Clark would have been set in a different order, a different "network architecture" could have resulted (Clark, 1988; Tronco, 2010). For sure, these goals have influenced the design principles and basic mechanisms that guided the original Internet architecture. But in fact, since its inception, the Internet is driven by a set of fundamental design principles rather than a formal architecture. These design principles play a central role in protocol implementations and engineering decisions. They also highlight the fact that there is no centralised control of Internet's evolution, but it rather relies in community's experimentation and implementation. Therefore the Internet's architecture does not really rely on a reference model (as

[1] Defense Advanced Research Projects Agency.

[2] Although research developments can be accounted for both the U.S. and Europe, the ARPANET is considered by many as the major building block of what later became the Internet.

[3] Donald Davies working independently of Baran at the National Physical Laboratory in England has also proposed packet switching (Russell, 2013).

Table 6.1: Ordered list of Internet's second level design goals as proposed (adapted from Clark (1988)).

Design Goal	**Description**
Internet communication must continue despite loss of networks or gateway.	Two entities communicating over the Internet would be able to continue operation without having to re-establish or reset their conversation in case some failure causes the Internet to be temporarily disrupted. introduces the fate-sharing model, translating the need for the network to dynamically adapt to failures.
The Internet must support multiple types of communications service.	This goal is the basis for the development of Transmission Control Protocol (TCP), which could run on top of most networks and guarantee reliable delivery of data between them. Although first thought as general enough to support any kind of services, it soon became clear that TCP was unsuitable for e.g. for services requiring low delay in delivery. User Datagram Protocol (UDP) was developed, a much simpler protocol, connectionless, unreliable, but a best fit for services with low delay requirements.
The Internet architecture must accommodate a variety of networks.	This goal translates the Internet requirement to handle heterogeneous networks. The Internet interconnects networks using a wide range of technologies and characteristics (such as delay, bandwidth, jitter, etc.) without the need to re-engineer every networking technology or update network elements.
The Internet architecture must permit distributed management of its resources.	Concerns the support for multiple administrative domains managed by different management centres. Clark highlighted the importance of management tools for resources' management in order to overcome manual operations and errors and pointed out for future changes in the Internet architecture related to this goal.
The Internet architecture must be cost effective.	Specifies the need for the Internet architecture to be as cost effective as any other more tailored architecture would be.
The Internet architecture must permit host attachment with a low level of effort.	The Internet architecture must support that a host changes its point of attachment dynamically and with a low level of effort, thus translating the need of the Internet architecture to incorporate mobility.
The resources used in the internet architecture must be accountable.	This goal is linked with the accountability of Internet resources. It has not been adopted and tools for accounting packet flows, usage or money flows have not been clearly delivered and used widely.

it might be implied by the definition of the term architecture). As Carpenter (1996) argued back in 1996, many members of the Internet community would claim that there never was an Internet architecture. The community would identify the Internet as having as its main *goal* connectivity, a *tool* which was the Internet Protocol, and *intelligence*, which was end-to-end rather than hidden in the network.

However, literature and Internet reference documents always refer to an *Internet architecture* and its *design principles*, which have guided the technical design of the network, especially the engineering of its protocols and algorithms. While Kahn (1972) was the first to introduce in 1972 the principle of an open network architecture, Saltzer et al. (1984) provided a first definition of the end-to-end principle. Carpenter (1996) contended in RFC1958 a snapshot of what were seen as the underlying principles of the Internet at the time — heterogeneity, transparency, scalability, performance, modularity, simplicity, interoperability, no security, and end-to-end principles.

Bush and Meyer (2002) elaborated on the simplicity principle[4], which states that complexity is the primary mechanism that impedes efficient scaling, and discussed its implications on the architecture, design and engineering issues found in large scale Internet backbones. Blumenthal and Clark (2001) discussed the benefits of the end-to-end arguments in preserving the flexibility, generality, and openness of the Internet, as well as in fostering innovation and development of new applications. They described several changes to network functions motivated by complex application requirements, which seem to be inconsistent with the Internet's end-to-end original philosophy.

Early in 1991, Clark et al. (1991) started raising questions about the future evolution of the Internet architecture and over the following years scholars have broadly acknowledged that the Internet was not designed to cope with the growing number of networked and mobile devices and applications, network environments, and business models, that have emerged over the past decades. These changes have posed new requirements on the architecture such as operational and management functions, new classes of applications and quality of service guarantees, security mechanisms, mobility, reliability, availability, and scalability. One such example of new requirements posed on the underlying network architecture relates to media content and services. Solutions to cope with quality of service (QoS) requirements have focused on adapting media characteristics to the current network architecture by defining middle layers, which accommodate new features to handle media content. Figure 6.2 shows such middle layers, which are in constant evolution to adapt to users and underlying network requirements. RTP/RTCP or MPEG-TS are well-known protocols and middle layer examples, which specifically adapt media content to the classical stack and requirements of TCP/IP communication (ISO/IEC, 2013).

The simplicity and transparency of the Internet have allowed this development of *adhoc* solutions to extend the architecture and its functions to cope with these new requirements, but in clear violation of the original key design principles (Blumenthal and Clark, 2001; Clark et al., 2005; Braden et al., 2000; Carpenter and Brim, 2002; Kempf and Austein, 2003). Many extensions have been developed as point solutions for specific requirements and short-term needs to satisfy the interests of vendors, users, or ISPs. They do not represent enhancements of the architecture and were largely developed disregarding the architecture's philosophy and impairing the Internet's

[4]Comparing the Internet Protocol stack with an hourglass, "the thin waist of the hourglass is envisioned as the (minimalist) IP layer, and any additional complexity is added above the IP layer" (Bush and Meyer, 2002).

long-term flexibility, reliability, and manageability (Peterson et al., 2005). Other examples of these extensions include firewalls to support end-user and site security, IP Security (IPSEC) which enables encrypted transmission of data, and Network Address Translation (NAT) to cope with the exhaustion of IPv4 address space (Braden et al., 2000; Stuckmann and Zimmermann, 2009).

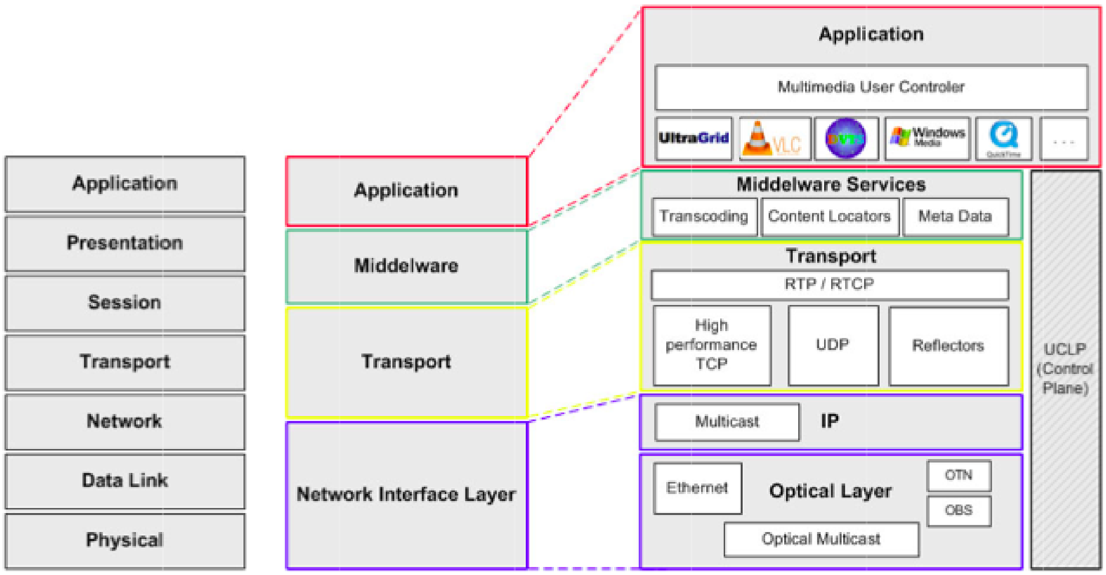


Figure 6.2: Middle layers or protocols used for media (ISO/IEC, 2013) (reproduced as in original).

Over the past decades, innovation has mainly occurred in the applications and underlying transmission technologies, rather than in the core of the network and the transport layers. But the growing demand of connectivity and capacity is currently straining the current Internet to the limits, restraining and slowing down innovation and the deployment of new technologies. The concept Internet ossification thus reflects this trend of limited incremental changes to the Internet architecture, which is imposing a significant barrier to innovation and preventing the adoption of disruptive technology (Stuckmann and Zimmermann, 2009; Turner and Taylor, 2005; McKeown and Girod, 2006). Figure 6.3 translates the current trends in innovation at the edges and little developments in the mid-layer protocols, namely IP, TCP/UDP, and the routing protocols. Towards finding solutions to the aforementioned limitations, two approaches to redesigning the current Internet are being considered.

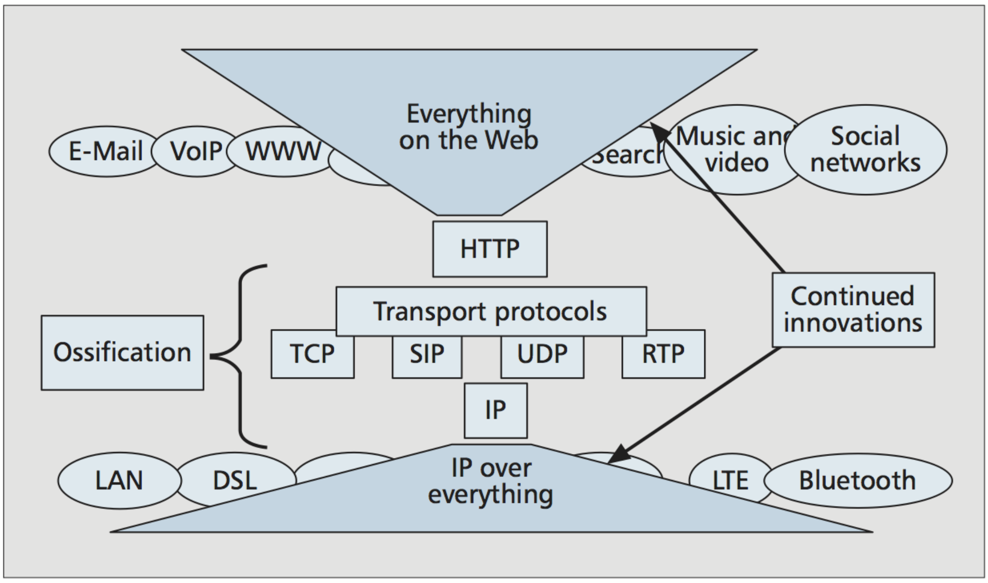


Figure 6.3: Innovation and ossification of the Internet (Stuckmann and Zimmermann, 2009).

6.2 Evolutionary versus Clean-slate Approaches

Two broad approaches are being considered in order to make the Internet move forward: evolutionary and clean-slate. The first one proposes to respect the current architecture and maintain backward compatibility, while the latter advocates for redesigning a new Internet from scratch. Although they seem to part in different directions, they might be in fact complementary to one another.

On one side, many believe that Internet's original architecture has already shown the capability to adapt to new services and applications and therefore the same approach of solving problems as they emerge should continue to be pursued, provided that backward compatibility and incremental deployment is ensured (Dovrolis, 2008; Rexford and Dovrolis, 2010). As Dovrolis (2008) contends, an evolutionary design is typically less costly, hence has more chances to be adopted in a competitive environment, and is more robust, as it evolved to survive a wider range of environments and objectives, instead of being optimised for a single environment.

On the other side, some argue that current Internet's challenges can only be solved through rethinking the fundamental goals and design principles underlying its architecture through a clean-slate approach (Talbot, 2005; Feldmann, 2007). Peterson et al. (2005) argue that continually patching the Internet will increasingly make it hard to manage and improve upon:

> "We've been on a track for 30 years of incrementally making improvements to the Internet and fixing problems that we see. Without a long-term plan, if you are just patching the next problem you see, you end up with an increasingly complex and brittle system." (Talbot, 2005)

Clean-slate research aims to design a new 'Future Internet' architecture that will tackle known problems and bottlenecks of the current Internet, without being constrained by the architecture or protocols currently being used (Rexford and Dovrolis, 2010), while also allowing for testing, experimenting and evaluating the new architecture. However, as Feldmann (2007) argues, both approaches will have to be synchronised on phased agendas at some point, as introducing new architectural principles will be very challenging for commercial and operational reasons. Potential paths for deployment will need to be identified, such as virtualisation, which would allow new network functionalities and protocols to be deployed, while ensuring logically independent networks to run side by side but relying on a common physical infrastructure (Stuckmann and Zimmermann, 2009). Feldmann (2007) also contends that the use of prototypes, such as experimental facilities, is crucial to run performance evaluations with scale and under realistic conditions in order to determine when the newly designed architecture is sufficiently good and to convince stakeholders to adopt the new architecture.

Table 6.2 briefly lists a number of research programs around the world to fund research and experimentation on Future Internet and Future Networks related topics. Most of the research developed in these programs takes a clean-slate design approach. Nevertheless, the basis of the European Framework Programme 7 (FP7), ICT Challenge 1.1. Future Networks has been to consider both clean-slate and evolutionary approaches (da Silva, 2007).

6.3 Standardisation Activities

Driven by the relevant research activities taking place worldwide and standardisation activities for specific FI technologies, standardisation development organisations (SDOs) ISO/IEC and ITU-T have initiated related work by identifying the general concept and definition of Future

Table 6.2: List of Future Internet research programs.

Research Program	Country	Start Year	Description
NewArch	USA	2000	DARPA-supported collaborative project, which attempted to reconsider the Internet architecture from scratch without adhering to the existing IP technology or end-to-end principle.
100x100 Clean Slate program	USA	2003	Developed novel clean-slate approaches to network design, access networks (optical and wireless), network control and congestion control.
FIND	USA	2006	Several projects promoting comprehensive network architecture design research have been funded. FIND intended to stimulate the architecture proposals to be implemented on GENI.
GENI	USA	2005	GENI intends to provide an infrastructure on which new architectures and network services can be implemented and tested.
Stanford Clean Slate Program	USA	2006	Funded by 7 industrial partners the program focused on 5 key areas for research: network architecture, heterogeneous applications, heterogeneous physical layer technologies, security, and economics and policy.
FIRE	Europe	2007	FIRE offers experimentation facilities for FP7 projects and emerging technologies, promoting experimentally-driven long-term research on new paradigms and networking concepts and architectures for the Future Internet.
FP7	Europe	2007	FP7 funded projects both with a clean-slate and evolutionary approach. Projects focused on among others new architectures, virtualisation, network management, mobility and heterogeneous environments, routing and resource sharing topics.
FI-PPP	Europe	2010	Deemed to accelerate the development and adoption of Future Internet technologies in Europe, advance the European market for smart infrastructures, and increase the effectiveness of business processes through the Internet.
AKARI	Japan	2006	Focused on the design of a New Generation Network architecture.
JGN2	Japan	2006	Offers a testbed to allow experimentation of the New Generation Network work elaborated in AKARI.
FIF	Korea	2006	Future Internet Forum sponsored some projects on future Internet clean-slate architecture work. The working groups focus on architecture, security, testbeds, services and wireless.
FIBRE	Brazil	2011	Funded by CNPq and the European Commission, its goal was to create a common space between the EU and Brazil for Future Internet experimental research in network infrastructure and distributed applications, encouraging and expanding bilateral cooperation in FI research and experimentation.
G-Lab	Germany	2008	Germany's national platform for Future Internet studies, included two major fields: research projects on FI technologies and design and setup of experimental facilities.

Network[5] (FN), as the term used to describe the Future Internet. Although IETF[6] is also working on standards for Future Internet, these are mostly related with FI supporting technologies (e.g. autonomic management, virtualisation, etc.) and not specifically with FN and design goals. The standardisation work developed on Future Network concept definition will be described in the following subsection. Further on, the second subsection describes the standardisation efforts towards content aware networks and media transport, in specific. Both groups are positioned in the clean-slate approach, although admitting that evolutionary design aspects are not excluded.

[5]The major difference between FN and Next Generation Networks (NGNs) is that no IP-based network architecture or packet switching technology is assumed for FN, whereas NGN is based on all-IP networks and packet-based transfer. Also, NGN research is based on short/mid term evolutionary approach focused on evolving from the current IP-based network, while FN is based on clean-slate design and a long-term approach.

[6]The IETF is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. The actual technical work of the IETF is done in its working groups, which include Applications, Internet, Network Management, Operational Requirements, Routing, Security, Transport, and User Services. The Internet Architecture Board provides architectural oversight (IETF, 2014).

6.3.1 Future Network

In 2007, ISO/IEC JTC 1/SC 6 (Joint Technical Committee 1, Subcommittee 6) initiated work on a new study item related to Future Network. The work at ISO/IEC was driven towards the elaboration of Technical Report (TR) 29181 Part 1 (ISO/IEC, 2012) describing overall aspects for FN including definition, general concept, requirements and a milestone for standardisation on FN. In separated parts of ISO/IEC TR 29181, specific relevant issues were considered, including naming and addressing, switching and routing, mobility, security, media transport, service composition and federation. Published in 2012, TR 29181-1 defines FN as "the network of the future made on clean-slate design approach as well as incremental design approach", providing "futuristic capabilities and services beyond the limitations of the current network, including the Internet". Following this definition, the vision of FN is depicted as in Figure 6.4.

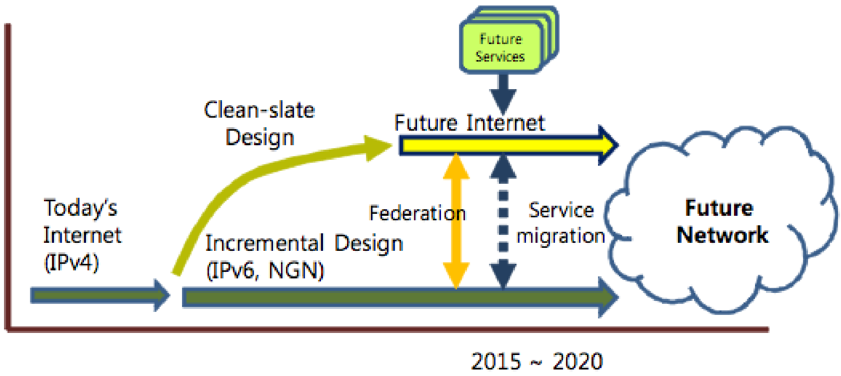


Figure 6.4: ISO/IEC TR 29181-1:2012 vision and roadmap of Future Network (ISO/IEC, 2012).

Additionally, the TR identifies twelve design goals and high-level requirements for the FN:

- Scalability: allow for a scalable routing and addressing architecture;
- Naming and addressing scheme: accommodate new rules facilitating the integration of various networks, to support new protocols, to provide bases for new applications and services, and to give support to new networking technologies, including backward compatibility with former architectures;
- Security: consider privacy concerns, authentication mechanisms for mobility, and heterogeneity of access technologies and applications;

- Mobility: support for seamless mobility for mobile users, terminals, and services, including user/terminal location privacy, route optimisation for mobile terminals, context awareness, seamless handover between access networks, and dynamic distribution of traffic among access networks;
- Customisable QoS: support for QoS and context awareness from user and application perspectives;
- Heterogeneity and network virtualisation: accommodate heterogeneous physical environments and new devices, such as sensors, support for data/content-centric services, support for network virtualisation, i.e., multiple isolated logical networks each with different applications, services, and architectures sharing the same physical infrastructure and resources.
- Service awareness: support for customised services based on user and service requirements and their context, reusability of existing component services for service providers, adaptation of composed services to changes of context or system factors;
- Media transport: support for content-centric engineering to realise efficient media delivery methods in order to provide the best possible quality within the actual user's context, support for content-centric design allowing users to access information transparently and with an enhanced findability, without knowing the place or address of the host, accommodate flexible business models in an open environment, ensure security and privacy, and access information spread over different locations;
- New layered architecture: create new interfaces between layers, redefine the layer boundaries, and provide cross-layer communication functions;
- Management: support for autonomic management (self-protection, self-healing, self-configuration, self-optimisation, etc.) of access networks and robustness in case of link and equipment failures, malfunctioning and denial of service;
- Energy efficiency: support for green ICT and energy saving capabilities;
- Economic incentives: support for QoS and quality of experience (QoE) from user and application perspectives, allow for easy management of emerging services and diverse architectures, support for customisability and accountability of services.

Following up on these objectives and goals, ISO/IEC work has focused on defining a general network architecture and on detailing the requirements for the building blocks composing that architecture (see Figure 6.5). In the following subsection, the work conducted by ISO/IEC on the Media Transport building block will be addressed.

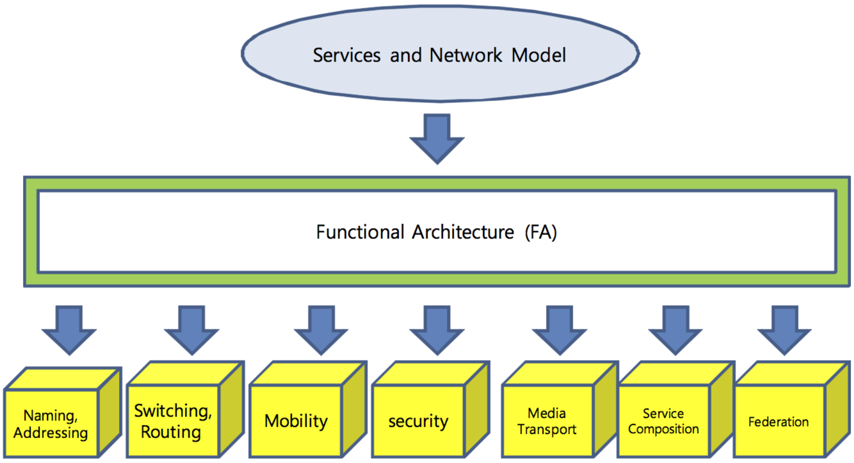


Figure 6.5: ISO/IEC TR 29181-1:2012 building blocks of FN architecture (ISO/IEC, 2012).

ITU-T has started the standardisation of Future Networks[7] assuming networking systems to be deployed roughly in the 2015-2020 timeframe. FN standardisation was approached by two complementary methods of analysis: top-down method working from objectives and design goals of FNs, and bottom-up method working from individual candidate technologies that are relatively mature. In 2009, ITU-T established a Focus Group on Future Networks under the aegis of ITU-T Study Group 13 (SG13) to share the discussion on and ensure global common understanding of the concept of Future Network. At completion of its work, the focus group finalised deliverables that were later transferred to SG13 and turned into ITU-T Recommendations Y.30XX series.

The main outcome of Focus Group on Future Network, ITU-T Recommendation Y.3001 (ITU-T, 2011), was adopted in 2011. It mainly describes the objectives and design goals that FN should satisfy, as depicted in Figure 6.6[8]. The recommendation defines Future Network as "a network able to provide services, capabilities, and facilities difficult to provide using existing network technologies". As such FNs are aimed at a unified infrastructure which connects and

[7]Note that, unlike ISO/IEC, ITU-T suggests that the plural form of Future Network can also exist. This denotes that there may be more than one network that fits the definition of FN.

[8]According to the Recommendation, the figure only shows the relationships between a design goal and its most relevant objective. However some design goals (such as network management, mobility, identification, reliability and security) may relate to more than one objective.

orchestrate the future Internet of people, devices, content, clouds, and things (Matsubara et al., 2013). Hence FN is either "a new component network or an enhanced version of an existing one, or a heterogeneous collection of new component networks or of new and existing component networks that is operated as a single network". The recommendation also describes FN in terms of four overall objectives which differentiate FNs from current networks: service awareness, data/content awareness, environmental awareness, and social-economic awareness. These objectives generally translate the need for FNs to: (1) provide services without significant increase in network deployment and operational costs; (2) allow users to access data in a quick, accurate and safe way, with the desired quality, regardless of the access network and users' location; (3) be environmentally friendly, consuming the possible lowest materials and energy; (4) be developed under costs and competition awareness, so that FN services are accessible to all players in the ecosystem, including users, vendors, network operators and service providers.

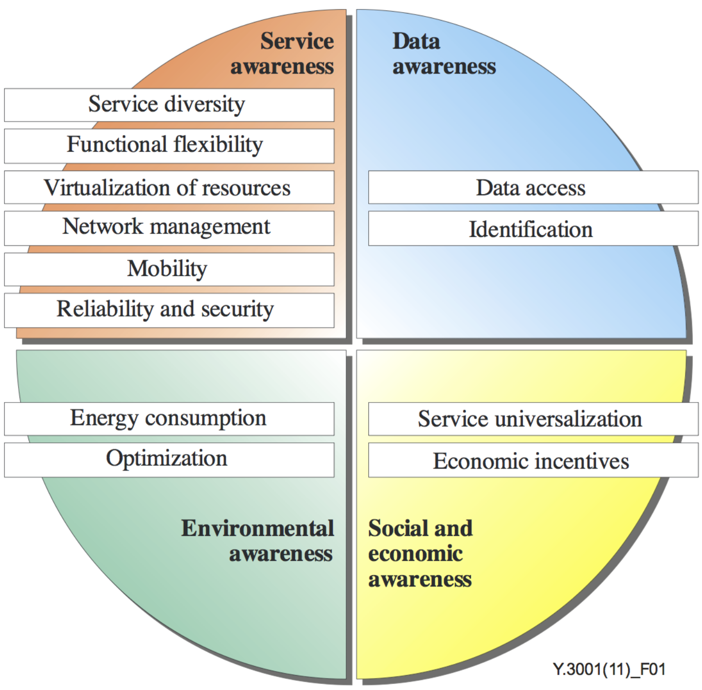


Figure 6.6: ITU-T Recommendation Y.3001 Future Network objectives and design goals (ITU-T, 2011).

Under these four objectives, twelve design goals, as required advanced capabilities and features for FN realisation, are envisaged:

- Service diversity: accommodate a wide variety of traffic characteristics and behaviours and support diversified services;
- Functional flexibility: support for agile deployment of new services that keep pace with the rapid growth and change of user demands;
- Virtualisation of resources: support partitioning of resources, so that a single resource can be shared concurrently by multiple virtual resources;
- Data access: embed mechanisms for retrieving data in a timely manner regardless of its location, for optimal and efficient handling of huge amounts of data;
- Energy consumption: support device, system, and network level technologies to improve power efficiency and to satisfy customers' requests with minimum traffic;
- Service universalisation: facilitate and accelerate provision of convergent facilities in differing areas such as towns or the countryside, developed or developing countries, by reducing network lifecycle costs and open network principles;
- Economic incentives: allow for a sustainable competition environment to various participants in the ICT ecosystem by providing proper economic incentives in designing and implementing the requirements, architecture, and protocol of FNs;
- Network management: ability to efficiently operate, maintain and provision the increasing number of services and entities;
- Mobility: provide high levels of reliability, availability and quality of service in an environment where a huge number of nodes can dynamically move across heterogeneous networks;
- Optimisation: ability to provide sufficient performance by optimising network equipment capacity based on service requirements and user demand, accommodating various physical limitations of network equipment;
- Identification: allow for a new identification structure that can effectively support mobility and data access in a scalable manner;

- Reliability and security: support for reliability and resilience, considering challenging conditions, while also taking in consideration users' safety and privacy.

The design goals presented in both standards are lightly described but a thorough analysis of the mentioned key capabilities and features leads us to conclude that many of them overlap to some extent. Figure 6.7 intends to provide a subjective interpretation of the level of similarity between the design goals of the two standards. Thicker arrows represent more similarity, while thinner arrows show less overlap between identified goals. Some of these similarities are specifically relevant for solving the challenges and bottlenecks related to media applications and services previously identified. Firstly, FN should accommodate services with a wide variety of traffic characteristics and behaviours, while providing the ability to optimise network equipment capacity based on service requirements and user demands. Secondly, FN should also provide support for customisable QoS from user and/or application perspectives along with support for service composition and context awareness. These key features will be particularly relevant to guarantee a seamless provisioning of media services. Thirdly, ISO/IEC establishes a design goal specifically for media transport wherein FN should support efficient methods to deliver media, conveying the best possible quality within the actual context of the user together with promoting flexible business models in an open environment. This design goal calls for a content-centric network design, which overlaps with the data awareness objective and the data access goal established by ITU-T but with a broader application, beyond media content. Finally, FN is recommended to be designed to provide a sustainable competitive environment for the various stakeholders participating in the ecosystem. The economic incentives should also provide support for the introduction of QoS and/or quality of experience (QoE) mechanisms from user and/or application perspectives.

Despite the design goals overlap, the two standardisation groups have worked independently, but have occasionally communicated and shared deliverables. From January 2011, the two groups established a correspondence group to identify common interest topics for collaboration and to develop technically aligned text and held a joint workshop in June 2012 with 78 participants. The main objectives of this workshop were to identify commonalities and differences in the work progressed by each group, to assess if those differences could be solved, and to investigate which

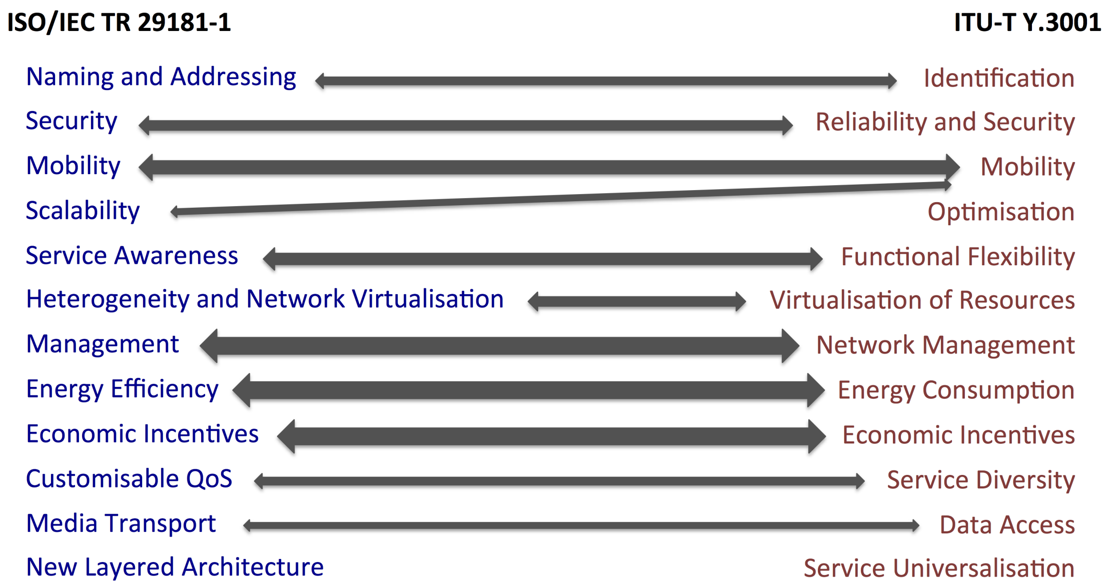


Figure 6.7: A graphical representation of the level of similarity between design goals presented in ISO/IEC TR29818-1 and ITU-T Y.3001.

standards could be developed as common texts. Meeting minutes of the workshop report on the necessary steps and difficulties to start developing common definitions (e.g. the issue starts right with the differences in FN definition) and common text or twin text specifications. Moreover, joint collaboration through a correspondence group and e-meetings was encouraged, together with face-to-face meetings whenever possible (Kang, 2012). It has been reported that the two groups, during the second semester of 2014, would collaborate towards the development of a common text regarding FN terminology (Kang, 2014), but no output has been published so far.

An analysis of the list of participants attending the eight meetings convened by ITU-T's Focus Group on Future Networks between June 2009 and December 2010 shows in a total of 45 different participants' affiliations that there was a high participation rate among network equipment and CE manufacturers, equalling the total number of participants coming from university and research institutes (Figure 6.8). Moreover, about a third of the participants represent European based institutions, followed by Japanese participants. Worth highlighting the absence of participants representing media services or products (Figure 6.9).

Despite numerous contacts with ISO/IEC JTC 1/SC 6 secretariat, comparable information about the affiliations of meetings' participants could not be gathered, as this information is not public. However, in an expert interview, the interviewee, an active participant at these meetings, indicated

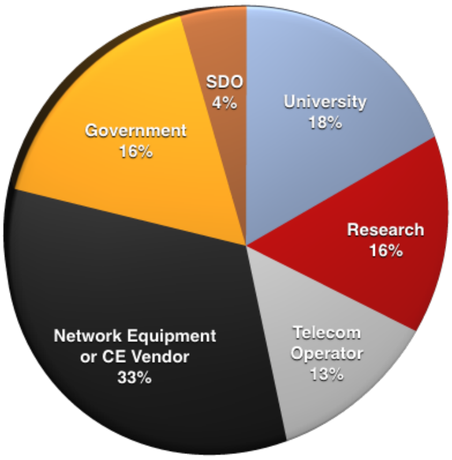


Figure 6.8: Stakeholder groups attending ITU-T Focus Group meetings on FN.

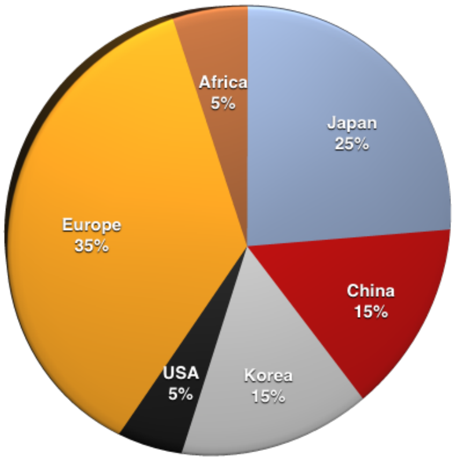


Figure 6.9: Countries represented in ITU-T Focus Group meetings on FN.

that the majority of participants were official country's national standards bodies or university researchers and professors, complementing and in representation of a national body.

6.3.2 Future Media

Both ISO/IEC JTC 1/SC6 and ITU-T SG13 have also worked on media and data aware requirements for Future Internet as a follow-up to the recommendations on the definition of FN, described in the previous subsection.

Part 6 of ISO/IEC 29181 (ISO/IEC, 2013), officially published in mid April 2013, identifies the general concept of FN media transport and details the requirements for the transport of media data over FN. Accordingly, the document defines media transport as the reference transport for the Future Network information based on the modular paradigm of a customisable container, for any kind of media content, both time-dependent and time-independent, or raw data, and is focused on defining services to fit the requirements for communications over heterogeneous networks supporting user preferences and their specific capabilities.

The approach described in ISO/IEC 29181-6 relies on service-centric networking, allowing to define services and compose multiple services in run-time or design-time, to fit the requirements for particular media communications over an heterogeneous context, for any kind of media content, either time-dependent or time-independent. Such approach would take in consideration two types of services: basic services (e.g. acknowledgement, sequence number, flow identification, congestion windows, etc.) and media services (e.g. content adaptation, scalability, transcoding, etc.), according to the capabilities of the parties involved in the communication and the media transport requirements. The key element in this architecture is called Media Aware Network Element (MANE). MANE is a node on the network, which is content and context aware, capable of processing media content to accommodate a given content or services according to the context (content type and properties, networking properties and status, and other environmental and conditional properties that may affect routing of content and services). MANE's capabilities include caching, adaptation, synchronisation, and media aware routing in an heterogeneous network, adapting to the changing user preferences and capabilities over time. That means MANEs have the capability to be aware of the content that is being conveyed and to react over that content according to the rules defined, depending on the type of media content, and in combination to network events/status awareness, such as congestion, in order to provide seamless media experiences to users.

In addition, ISO/IEC 29181-6 identifies the main requirements for media transport, focused on the support of:

- any type of media content including current and future types of media ranging from very low to very high data rates and requiring different levels of QoS/QoE, and various types of communications such as point-to-point, point-to-multipoint, and multipoint-to-multipoint;
- differentiation at content level in order to enable a prioritised delivery based on media content;
- the identification of media content, media devices, and user preferences;
- a wide range of devices able to consume or generate media content (i.e. smartphones and smart TVs) and provide suitable media transport service;
- suitable delivery, in terms of delay and/or reliability (losses), of data and content (time-independent media objects and time dependent media objects);
- inter-module information exchange and incorporation of QoS/QoE related information from different modules (i.e., network module, application module, etc.);
- content adaptation through techniques such as layered coding and multiple description coding, among others;

- an adaptive and tailored container for each communication according to both content and network requirements, either in run-time or design-time;
- adaptation of the dynamic characteristics of media according to both content and network requirements, as well as user preferences and choices;
- security at media level to ensure privacy and trustworthiness;
- heterogeneous devices as nodes of the network which will be able to initiate, handle and finalise tailored media content transmissions;
- the principles of simplicity, flexibility, scalability;
- seamless use of heterogeneous network environments and mobility of users along different networks and attachments.

Finally, the technical report presents several use cases, among which is the one detailed in Figure 6.10, to demonstrate MANE capabilities, such as being aware of media content types and network status. This example shows two main streams, one conveying time-dependent media data (server 1 acquiring live video) and the other time-independent (server 3 serving, for example, VOD content), flowing through MANE elements. In the event of network congestion, MANE reacts by adapting media content according to its characteristics. For time-independent content, data may be queued and sent at bursts instead of following a continuous stream, while for time-dependent media, MANE may perform different actions depending on its capabilities and the characteristics of the content, such as dropping less important packets of scalable content or adapting the content to the network status. In both cases, congestion is signalled back to the source, so that the latter can make the right adjustments.

ITU-T Y.3033 (ITU-T, 2014), published at the beginning of 2014 and entitled "Framework of data aware networking for future networks", identifies the design goals for data aware networking (DAN), in relation to one of FN objectives, data awareness, defined in ITU-T Y.3001. Although ITU does not specifically addresses media content, the document underlines all forms of video (TV, video on demand, Internet and P2P) as one of the forms of data generating high amounts of traffic in the current Internet, which would benefit from DAN.

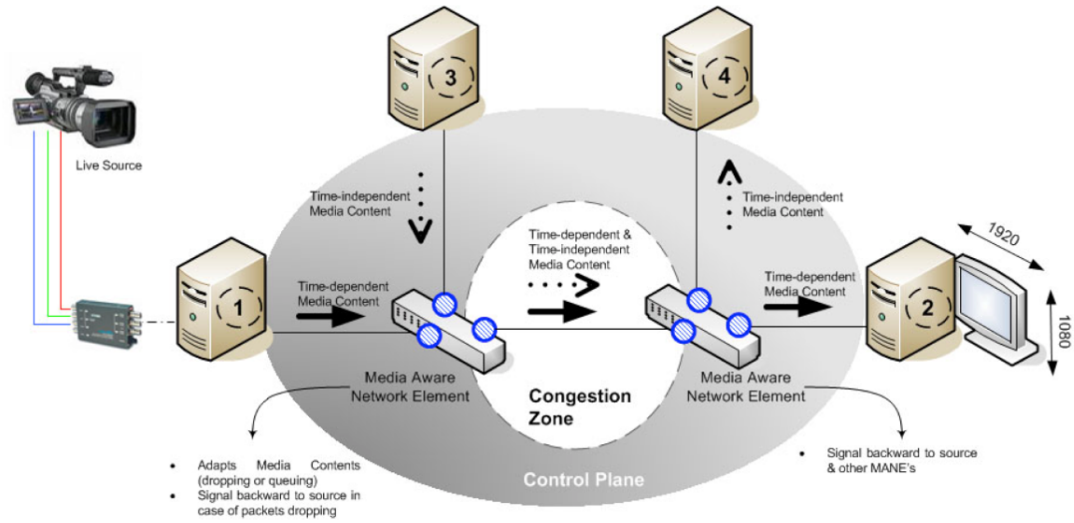


Figure 6.10: Example showing ISO/IEC 29181-6 MANE elements reacting to network congestion (ISO/IEC, 2013).

DAN is defined as a network architecture that would have the capabilities to deal with enormous amount of data efficiently in a distributed environment and enable users to access desired data safely, easily, quickly and accurately, regardless of data locations, while also being aware of the user context and reacting accordingly in order to support adaptive data distribution. The key essence of DAN lies in the name based communication that routes a data object in the network by its name or identifier (ID) and not an IP address. This name based communication enables intermediate network elements to recognise the data name or ID as well as its attributes which are provided for the network, and make a decision based on them, with the aim of optimising the distribution of data objects. By optimising data distribution, users can experience higher throughput and lower latency, and network resources can be saved by reducing redundant traffic. In addition, the name based communication allows a data object to be retrieved regardless of its location, which ensures the seamless continuation of communication associated with the names of data objects, i.e. handling mobility in a transparent way in case their location changes.

Moreover, ITU-T recommendation sets seven design goals related with DAN architecture:

- DAN should provide data objects with persistent and unique names, so that users can access a data object simply based on its unique name regardless of its location;
- DAN should incorporate a security mechanism in order to allow a user of a data object to verify its validity and integrity;

- The routing scheme in DAN should be scalable to support a large number of data objects;
- DAN should allow the end hosts to communicate without establishing or managing an end-to-end connection, thus simplifying the mobility aspects of the end terminals;
- Each network element in DAN should support a caching mechanism and also be able to inspect user requests that pass through it so that it can make a decision on user requests and respond using the cached data objects;
- DAN should support two types of application programming interfaces (APIs) for data object distribution and retrieval from the network. The first one, put/get APIs, allow applications to request and pull a data object from its serving network element, while the second, publish/subscribe APIs, allow applications to specify which data object is wanted, and this object to be delivered once it is published;
- Two types of transport mechanisms should be supported: the receiver driven transport, where the receiver sends requests for specific pieces of a data object to the sender, being the receiver responsible for maintaining reliable data transmission; the sender driven transport, where the sender controls sending rate of the pieces of a data object while performing loss detection and congestion control.

Finally, ITU-T Y.3033 presents three use cases illustrating DAN's capabilities (Figure 6.11). In the first case in the figure, a user request for a data object is routed to the provider of that data object. While the data object would normally be downloaded from the provider, it can also be downloaded from other DAN elements along the downloading path and closer to the user, where the data object might be stored. In the second case, a user request for a data object can be answered by any DAN element closer to the user where the data object is cached or stored, so that the request does not need to be routed to the original provider. In the third case, DAN elements can process the data object before they respond to the requester so that the format of the data object fits the capabilities of the user's terminal.

Even though the two standards intend to achieve the same kind of objectives, two different approaches have been chosen. On the one hand, ISO/IEC 29181-6 argues for service-centric

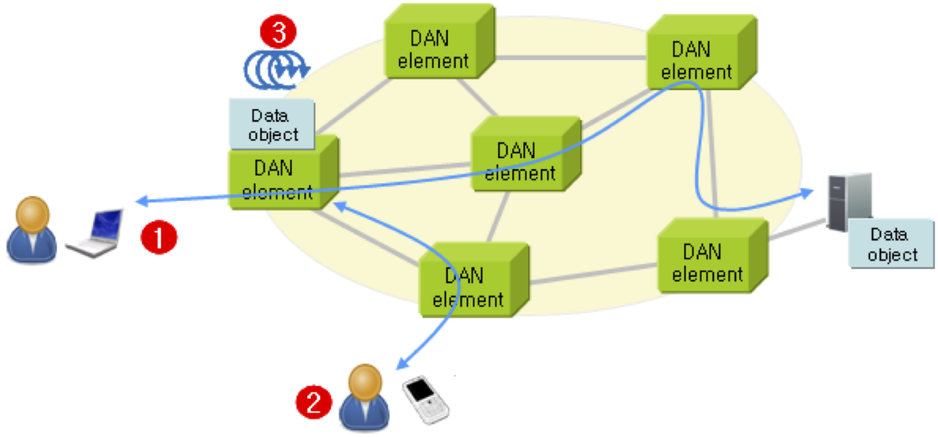


Figure 6.11: ITU-T Y.3033 data aware networking use cases (ITU-T, 2014).

networking, although ISO/IEC 29181-1 seemed to posit that FN should rely on content-centric networking for media transport. On the other hand, ITU-T Y.3033 contends a data-centric networking solution, also known as information- or content-centric networking, for all types of content delivery. Nevertheless, the service-centric approach advanced by ISO/IEC 29181-6 appears to extend the concepts of content-centric networking, but with the capabilities to support service composition (basic and media services) facilitating and potentially incorporating media processes. Both approaches aim to deliver seamless mobility, caching, trustworthiness, security, support for different levels of QoS/QoE and heterogenous environments. In addition, the ultimate goal in both cases is to provide a suitable delivery of content, overcoming congestions and delays, to a wide range of devices in different user and network contexts. This will only be possible by knowing the type and characteristics of the content that is traversing the networks. Only ITU-T Y.3033 provides support for named content communications though.

6.4 European Future Media Internet Initiatives

The Future of the Internet conference held at Bled, Slovenia, in 2008, was the landmark for Europe's Future Internet initiatives, including activities related with Future Media and new media content. One of the most relevant outcomes of this conference was the decision to create the European Future Internet Assembly (FIA). FIA[9] was composed of a Steering Committee coordinated by

[9] Since 2015, FIA has been replaced by Net Futures Conference, to be held annually. The goals are in essence similar to FIA events, although the first event reveals new tracks on experimentation and reaching the market.

the European Commission and was driven by work to be developed at working groups and get together events to be held twice a year. Many specific thematic working groups and task forces have been created and supported at FIA events over the following years. This section describes three initiatives that emerged from FIA with active participation from its contributors and participants. These initiatives largely influenced, supported and shaped European research and were essential to boost collaboration between projects. It is worth highlighting their work, since the standardisation documents analysed in the previous sections make a considerable number of references to European research and projects. For each initiative presented below, its objectives and contributions to Future Media agenda are described. All three initiatives take a content- or information-centric networking approach. In order to later address the first research question of this study, an analysis of the affiliations of the contributors to each of these initiatives is also presented.

6.4.1 Future Content Networks Group

The Future Content Networks (FCN) group was created just before the first FIA event with the name Content creation & Media delivery cluster having as main aim to identify and emphasise the impact that both media and networks (networked media) would have on a Future Internet environment. Its main objectives mainly concerned:

1. the identification of the limitations of the current Internet with respect to media processing and networks,
2. the identification of the design principles and main components of a Future Internet Architecture,
3. assist the sketching of a reference Future Internet Architecture[10],
4. the identification and analysis of usage scenarios and research challenges that need Future Internet to be realised, and
5. the dissemination of the goals and results of the group.

For the first FIA meeting, the FCN group prepared an initial paper reflecting on the future of networked media, its conceptualisation and technological achievements. The group perceived the

[10] A specific working group, FIArch group, was created later on in 2010 to focus specifically on architectural issues and limitations of the current Internet and contribute to an European research roadmap towards Future Internet Architecture.

need to overcome current Internet limitations through a cross-domain revolutionary, rather than evolutionary approach. Future Internet was envisaged to "provide the means to share and distribute (new) multimedia business and user centric services, with superior quality and striking flexibility, in a trusted and personalized way, improving citizens' quality of life, working conditions, edutainment and safety" and its deployment would be driven by "new alliances between traditional IT, telecom, mobile service providers, media companies, suppliers of consumer electronics, (multimedia) search engine companies and other powerful players" (FCN, 2008b). In addition, the group expected that three main technological achievements would be met by 2015: (1) the "challenge of true broadband", allowing high bandwidth rates (at least Gbps) to be offered at affordable fixed and mobile broadband services, (2) the "challenge of personalised intelligent media", considering real-time adaptation, interactivity and user inclusion as research strands, and (3) the "challenge of distributed control", where neither the infrastructure nor the service is controlled by a single entity. Hence, the FCN posited a Future Internet with, among other features, a high bandwidth, real-time and low delay transmission, user centric, catering for specific media end-to-end QoS provisioning, enabling media content to be optimally transported through the network.

A second position paper prepared by the group presented an initial perspective of the Future Media Internet's requirements taking into account future trends related to an increasing amount of user generated content, enhanced content representations (3DTV, Ultra HD TV, etc.), new forms of interactive and collaborative storytelling and serious games. These requirements were oriented towards a content-centric paradigm:

- Be designed for tussle[11], supporting a range of different and new business models based on flexible virtual dynamically scalable topologies;
- Offer accountability for network resource usage at content level, so that network resource usage could be quantified for content delivered to the end-user, enabling new business models for media delivery;
- Be more content and context-aware by supporting network based capabilities which would be able to handle search, storage, different types of distribution, manipulation, protection and

[11] The term "tussle" has been coined by Clark et al. (2005) and describes the clash of interests between Internet stakeholders. Key principles to be ensured include: freedom of choice, openness of access, removal of barriers to innovation and means of establishing trust.

authentication of distributed media content objects;

- Support more symmetrical end-to-end data throughputs in the Gigabit range and edge based distribution of content;
- Offer secure, manageable and context-sensitive content services, adjusting the network protocols and optimising the personalisation of content in real-time, the network and terminal-awareness according to the user context and the configuration of the logic network topology (FCN, 2008a).

Further on, the group specifically addressed FI from a content-centric approach. A content-centric Future Internet follows from the assumption that content and content representation will be the basis of the Future Internet as these will be what users will mostly enjoy in the future and hence the need to focus on enhancing users' media experience. The group proposed a number of design requirements that would provide the basis for the Future Content Centric Internet and hence to attain the vision of a Future Internet fully suited for future users' needs. From a media-centric perspective, the following requirements would support a full media experience:

- Content centric engineering, supporting new ways of storing, coding, enriching, finding and rendering content, where the content is treated as having meaningful semantic connotations rather than simply a set of pixels that have been encapsulated in packets for transmission over the network;
- Name resolution and "findability", in order to handle access to content regardless of knowing where content is located, the URL or IP address of the server that hosts it, or network topology. Findability would enable users to locate on the network by using the "Find" operational primitive, while content providers would publish data objects and associated information by using the "Register" primitive;
- Content centric routing, allowing users to fetch particular pieces of information from the most convenient location or locations based on the user's requirements (e.g., minimising download time or minimising latency for real-time content). Such an approach would lead to multiparty to multiparty information dissemination rather than traditional point to point communication;

- Flexible content business models, supporting flexible business models where multiple stakeholders can participate in an open environment that supports and encourages innovation and participation by users (individuals or communities), ISPs, content and service providers, public and private organisations and regulators;
- Trustworthiness of content and media services, guaranteeing privacy of each participant in a media transaction and securing networks against breakdown and malicious attacks;
- Source and presentation choice, enabling users to decide how and from whom content is fetched, when content is available from multiple players in various presentation formats. Content should be available in different formats and an appropriate format should be presented in accordance to user's preferences and context. In addition, network resources should be automatically allocated to deliver content according to specific formats and presentation modes;
- Decentralised self-organisation, allowing networks to reconfigure and self-organise automatically in order to securely serve named content (FCN, 2009).

From the same content-centric perspective, the group envisioned the following principles towards the design of Future Internet:

- Support for multiple and new business models, wherein multiple stakeholders should be able to participate in a supportive and open environment. In addition, the Future Internet could host various embedded architectures, one of them being content centric;
- Simplicity, in order to keep the FI as simple as the current Internet, making the use of the network functionality simple and robust;
- Sustainability, scalability and robustness, in order to build the FI as a sustainable network, offering built-in support for energy efficient solutions, being flexible enough to continuously evolve, and to develop and extend in response to changing societal requirements. FI should be able to serve a very large number of entities (scalability), maintaining its usable operation ratio (availability) and can easily recover if faults occur (reliability);
- Loose coupling, in order to keep FI components and systems loosely dependent from each other allowing for more flexibility (FCN, 2009).

The FCN group gathered experts mainly doing research in academia and in industry from about forty FP6 and FP7 European funded projects. An analysis of the professional affiliation of the attendees of five meetings of the FCN group which took place between January 2010 and October 2011 as well as of the contributors to three position papers published by the group is depicted in Figure 6.12. In a total of 52 institutions represented, the group was largely driven by research and academia. Nevertheless, worth highlighting the representation of BBC, Yahoo, Microsoft and other IT/software-oriented firms, which would potentially have a stronger media and software perspective, rather than a network perspective.

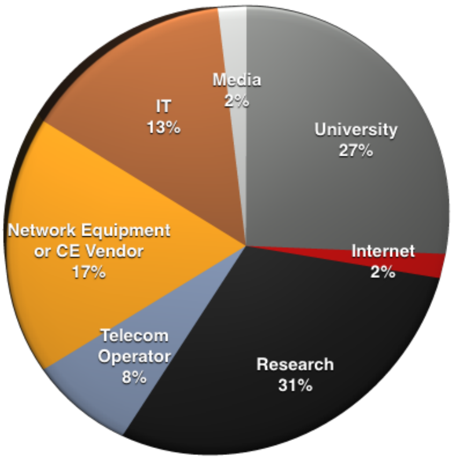


Figure 6.12: Stakeholder groups attending FCN meetings and contributing to group's papers.

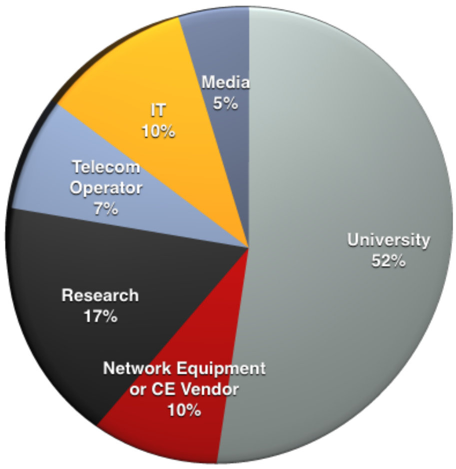


Figure 6.13: Stakeholder groups attending FMI-TF meetings and contributing to task force's papers.

6.4.2 Future Media Internet Task Force

The Future Media Internet Task Force[12] (FMI-TF), was also created by the European Commission in 2008 and gathered 35 experts coming from Europe, U.S. and Korea. Figure 6.13 depicts the industries to which attendees of the meetings (three meetings between February 2010 and April 2011) belonged to and contributors to six position papers published by FMI-TF. A great extent of the work of the task force overlaps with FCN's work, in time, contributors and in content. Although the distribution of stakeholders among telecom operators and network equipment and CE vendors is very similar to FCN, two broadcasters, BBC and RTVE, have contributed to the work of the task force.

[12]Created as Future Media and 3D Internet Task Force and later renamed to Future Media Internet Task Force.

The task force was initially coordinated by five Network of Excellence projects (CONTENT, EMANICS, INTERMEDIA, VISNET II and PETAMEDIA) and aimed at identifying the main problems of the current Internet and Media systems as well as reflecting about the design of the Future Media Internet. From November 2009, nextMEDIA project assumed the coordination of this group. The group's main objective from then onwards was to identify new research challenges for the next 5-10 years in the areas of Future Media and Content aware networks. The specific goals of this initiative were:

1. identify the relevant research areas with respect to Future (3D) Media and content centric networks and hence support Future Media Internet;
2. identify and report state of the art and relevant standards in these areas;
3. report limitations of the current systems;
4. identify relevant commercial systems;
5. propose new research challenges;
6. identify added value for the industry;
7. sketch potential relevant scenarios and use cases (Daras, 2010a).

The task force defined Future Media Internet as

> "(...) the Future Internet viewpoint that covers the creation, delivery, in-the-network adaptation/enrichment and consumption of media over the Future Internet ecosystem." (FMI-TF, 2011)

whilst Media Internet included two main aspects:

> "Media being delivered through Internet networking technologies (including hybrid technologies) and Media being generated, consumed, shared and experienced on the web." (FMI-TF, 2011)

In 2008, the task force published an initial white paper reflecting on the research challenges and potential scenarios for Future Media and 3D Internet. Figure 6.14 captures the vision of the

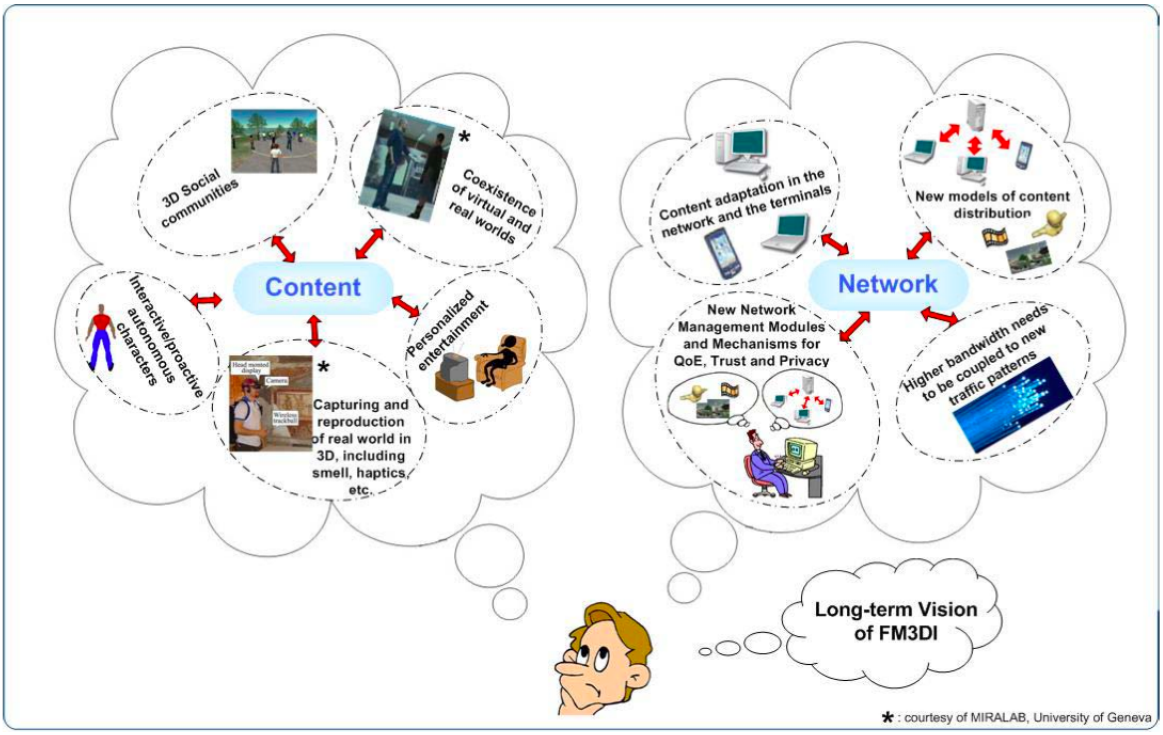


Figure 6.14: Characteristics of Future Media 3D Internet according to FMI-TF experts (FMI-TF, 2008)

experts' group about the relevant characteristics of the Future Media Internet, which are in essence, very similar to the views expressed by the FCN group.

In liaison with the FCN group, FMI-TF published in 2009 a report (FMI-TF, 2009) intended to highlight the differences between the design requirements and principles of the Future Internet and the design requirements and principles of the Next Generation Network (NGN) initiative initiated by standardisation body ETSI. FMI-TF argued that NGN standardisation efforts were focused on improving the Internet architecture in the short and mid-term and mostly focused on telephony, high-speed Internet access, and television, and the networking aspects needed to provide these services, leaving out requirements related with content-centric networking.

Following from this analysis, the group identified, from a content-centric approach, the key aspects for a successful redesign[13] of the Internet. The five key design requirements identified are:

- Content centric engineering, focusing on the capability of dynamically performing content resolution changes in order to deliver the best quality under a given bandwidth budget and

[13]FMI-TF did not assume a clean-slate or evolutionary approach, but rather assumed a position of identifying "the problems of the current Internet and propose solutions for providing media and 3D content via the Internet in the next decade" (FMI-TF, 2008, p.6).

applications that can tailor content quality and size to optimally fit terminal requirements. These requirements are network agnostic and are essentially connected with new ways of storing, coding, enriching and rendering content;

- Content centric network design, involves two characteristics: content centric routing and "findability". The first allows users to access particular pieces of information and media objects without needing to know the name or IP address of the hosts that contain the content, i.e., it should be possible to name information and media objects independently of their location. The second characteristic, enables content to be easily discovered, searched and retrieved using new types of content routing (by name, meaning, type, context, creation date, description, etc.);

- Design for tussle, enabling FI to support flexible business models where multiple stakeholders can participate in an open environment that supports and encourages innovation and participation. FMI-TF considers this as one of the most important elements of the FI and possibly the main differentiating point between NGNs and the envisioned FI;

- Trustworthiness, ensuring protection and privacy for all the stakeholders and content involved in a media transaction;

- Flexibility, referring to how a user fetches a particular piece of information stored at multiple locations and accommodating trade-offs between the interests of involved stakeholders. This also refers to the appropriate allocation of resources (e.g., network capacity) for particular content (FMI-TF, 2009).

In addition, three main FI design principles are derived from the design requirements, still taking a content-centric perspective, but mostly addressing social, economic and policy rather than technological aspects. The first principle refers to keeping systems simple, choosing simpler and more elegant solutions to complex problems. This has been one of the guiding principles of the current Internet and should continue to be taken into account in the FI. The second, refers again to design for tussle and the need to engineer FI in order to support flexible business models where a particular stakeholder is not favoured over another stakeholder. The third and last principle, refers to designing FI as a sustainable network, flexible enough to continuously evolve, develop and extend in response to changing societal requirements. FI sustainability would largely rely on its ability to be scalable, available and reliable in a resource- and cost- efficient manner.

In a final report of September 2011, the task force reported on the main and most important research challenges for Future Media Internet (FMI), identified and classified by the experts in the group. In total, seven research challenges were identified, which are mostly related with a media and information, rather than a network perspective:

1. Scalable multimedia compression, transmission and concealment in order to achieve content and context adaptive cross-layer optimisation of resources for controlling the rate versus quality of experience trade-off. Coding and transmission technologies, able to engineer the content to meet demanding and variable application requirements, are critical;

2. Network coding and streaming, aiming at adding intelligence and computational power to network nodes. Network coding is an emerging paradigm for media and generic data communication, which offers a more general approach to media delivery than that of conventional communication networks by assuming that nodes will be able to process and code media streams and not just route them. It has the potential to dramatically increase the network transmission capability and performance;

3. Content and context fusion technologies for improved multimedia access, allowing systems to capture the user behaviour and context, and to perform content and context fusion, such as location, the status of the user when consuming multimedia, etc;

4. 3D content generation leveraging emerging acquisition channels, allowing 3D technology to be fully adopted by the home consumer. However, several research challenges need to be investigated and solutions are needed to simplify the generation of 3D content and provide the users/producers similar hardware and software facilities as those enjoyed today by 2D video makers and users;

5. Immersive multimedia experiences, encompassing the integration, display and transmission of multisensor information, such as haptics, gesture recognition, 3D body recognition etc.;

6. Multimedia, multimodal and deformable objects search, in order to implement personalised and user-centric mechanisms to deliver only the content that is of interest to a particular user and to improve quality of experience;

7. Content with memory and behaviour, which will adapt to users, context and purpose, and will remember, react, interact and thereby become bi-directionally immersive, allowing a transition from smart content to intelligent content.

6.4.3 Future Media Internet Architecture Think Tank

The Future Media Internet Architecture Think Tank (FMIA-TT) was created within the scope of the nextMEDIA FP7 project, which ran between 2010 and 2011. The aim of FMIA-TT was to gather renowned experts from U.S. and Europe in the area of content and networks, to discuss and produce a proposal for a reference model of a Future Media Internet Architecture, as part of a generic Future Internet Architecture. Most of these experts were affiliated with research centres and universities and one or two experts from telecom operators, Internet firms (Google), network equipment and CE vendors and IT firms (Figure 6.15).

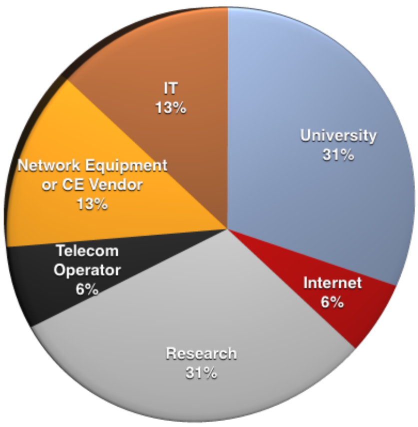


Figure 6.15: Stakeholder groups part of FMIA-TT experts.

The objectives of the work of the FMIA-TT were the following:

- Identification and analysis of the problems of the current Internet and future requirements;
- Comparison of the different architectural visions and identification of weaknesses and strengths of the best alternatives as well as open issues;

- Identification of the design principles and techniques of the Future Media Internet;
- Draft of a proposal for a Future Media Internet Architecture and identification of methods for its validation (Daras, 2010b).

The Think Tank concluded its work by proposing a Future Media Internet Architecture reference model with the input of its members and additional external experts, who were invited to a workshop to discuss intermediate results. The high-level Future Media Internet network architecture (Figure 6.16) consists of different virtual hierarchies of nodes (overlays, clouds or virtual groups of nodes), with different functionalities (Tsiodras, 2011). In a realistic scenario, deployment is expected to be incremental and the number of layers can actually be higher than three. The proposed architecture is expected to be backward compatible with the current Internet.

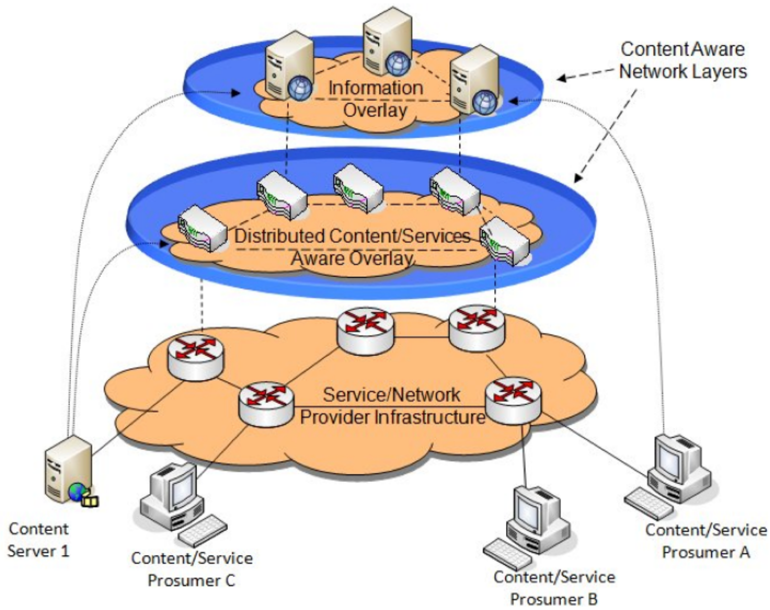


Figure 6.16: High-level Future Media Internet network architecture (Tsiodras, 2011).

In the lower layer, the Service/Network Provider Infrastructure Overlay, users are expected to be both content producers (for user generated content) and consumers. In addition, in this layer network nodes with limited functionality and intelligence can be found. Therefore, content will be routed, assuming basic quality requirements and, if possible and needed, cached to some extent in this layer. The middle layer, the Distributed Content/Services Aware Overlay, is constituted of content-aware network nodes (e.g. edge routers, home gateways, terminal devices). These nodes will have the intelligence to filter content and Web services that flow through them (e.g.

via deep packet inspection) and to identify streaming sessions and traffic. This information will be reported to the higher layer. At this layer, virtual overlays may be considered for specific purposes, e.g. content caching, content classification, network monitoring, content adaptation, optimal delivery/streaming, etc. Moreover, nodes at this layer will have information about the content and the content type/context that they will deliver, thus allowing for hybrid topologies to be constructed, customised for streaming complex media such as Scalable Video Coding (SVC) or Multi-view Video Coding (MVC). At the highest layer, Content/Services Information Overlay, intelligent nodes or servers that have a distributed knowledge of both the content/web-service location/caching and the (mobile) network conditions can be found. Content may be stored/ cached at the Information Overlay or at lower hierarchy layers, though this overlay will be always aware of the content/services location/caching and the network information. Based on this information, it would be possible to decide on the way that content would be optimally retrieved and delivered to subscribers.

Table 6.3 summarises the three initiatives analysed — their objectives, the identified FI design requirements and principles, as well as the FMI design requirements. FCN and FMI-TF initiatives were very similar in terms of work performed, outputs and views about FI and FMI. They have both chosen a content-centric networking perspective to elaborate on future design requirements and to overcome current Internet limitations related to media transport and delivery. Inspired by this work, FMIA-TT gave a step forward and proposed a reference model for an FMI architecture, which is comparable to other content-centric networking architectures proposed in European and U.S. projects (for a review of these architectures see Ahlgren et al. (2012); Alduán et al. (2012); Xylomenos et al. (2014)).

Table 6.3: Summary of European Future Media Internet related initiatives - key requirements and design principles.

	Objectives	**Future Internet Design Requirements (content-centric)**	**Future Internet Design Principles (content-centric)**	**Future Media Internet Design Requirements**
FCN - Future Content Networks group	• Identification of current Internet limitations for media processing • Identification of design principles of a Future Internet Architecture • Assist the sketching of Future Internet Architecture • Identification and analysis of usage scenarios and research challenges for Future Internet • Dissemination of goals and results	• Content-centric engineering • Name resolution and "findability" • Content-centric routing • Flexible content business models • Trustworthiness of content and media services • Source and presentation choice • Decentralised network self-organisation	• Support multiple and new business models • Support for various embedded architectures • Simplicity • Sustainability • Scalability • Robustness • Loose coupling	• Design for tussle • Accountability of network resource usage at content level • Content and context-aware network based capabilities for media content • Support for end-to-end data Gbps and edge based content distribution • Context-sensitive and real-time personalisation of content according to the user context, network topology and user terminal
FMI-TF - Future Media Internet Task Force	• Identification of relevant research areas with respect to Future (3D) Media and content-centric networks • Reporting on state of the art and relevant standards in these areas • Identification of limitations of current systems • Identification of relevant commercial systems • Propose research challenges • Identification of added value for the industry • Sketch potential relevant scenarios and use cases	• Content-centric engineering • Content-centric network design • Design for tussle • Trustworthiness (protection and privacy) of stakeholders and content • Flexibility in fetching/locating content	• Keep it as simple as possible (KISP) • Design for tussle • Sustainability	• Scalable multimedia compression • Network coding and streaming • Content and context fusion • 3D content generation leveraging emerging acquisition channels • Immersive multimedia experiences • Multimedia, multimodal and deformable objects search • Content with memory and behaviour
FMIA-TT – Future Media Internet Architecture Think Tank	• Identification and analysis of the problems of the current Internet and future requirements • Comparison of the different architectural visions as well as open issues • Identify design principles and techniques of the Future Media Internet • Produce a proposal for a Future Media Internet Architecture and identify methods for its validation.		• Keep it as simple as possible (KISP) • Consumer-end only principle • Design for tussle • Sustainability	

6.5 Conclusion

The design goals and requirements for Future Network and Future Media Internet overviewed in this chapter address a number of limitations of the current Internet regarding transport and delivery of content.

These design goals and requirements for Future Media architectures would provide networks with caching capabilities, content naming, name resolution and data routing, security and trustworthiness, customisable QoS and QoE, content delivery prioritisation, context awareness, and seamless mobility. These goals will be considered in the next chapter as technological triggers that may impact the evolution of online video services. Worth noting that within the scope of specific architecture implementations, other potential technical capabilities could be delivered.

The proposed Future Media networking represents a shift from the current paradigm, host-centric, in which communication is established point to point, to an information-centric paradigm, in which content is kept in the network itself. CDNs already provide several features of this paradigm but at an overlay level. In order to efficiently distribute content to the end-users, CDNs have become a mandatory requirement among content and service providers. CDNs perform content replication in surrogate servers distributed closer to the end-user in order to improve content accessibility, lessen the load of the servers where the original content is located resulting in reduced congestion within a network (Trossen and Kostopoulos, 2012). This means that several copies of the same content are cached in several servers around the world (or according to the specifics of the service) typically hosted at ISPs, since these are the closest connecting point to end-users. The Future Media paradigm would not only rely on surrogate servers, but would enable caching directly in network elements. Together with name resolution and data routing, the network would provide full content lookup functionalities and allow content to be cached and retrieved from the closest user location along the delivery path. In this future scenario, it is not clear how CDNs could fit, as much of their functionalities would be provided by the network itself.

In this FMI paradigm, ISPs would also have information about which 'kind' of traffic is traversing their networks, unlike the current state, wherein such information can only be obtained by using techniques such as deep packet inspection (DPI). Moreover, ISPs would be able to customise QoS and prioritise content delivery to their benefit, or users' and service providers' benefit. That said, traffic throttling practices, slow and fast lanes or premium pricing schemes are facilitated.

However, by automatically adapting QoS and QoE for content delivery according to traffic status (e.g. congestion), network capacity, content demand, user context and user devices, would greatly enhance customer and viewing experience. In several interviews, service providers have however devalued content adaptation to the user and device context as an important requirement, as this is perceived to be already achieved with overlay protocols such as MPEG-DASH.

Regarding security and trustworthiness, the FMI paradigm would allow content itself to be secured, instead of the end-to-end connection that transports it. This would enable DRM mechanisms to be applied directly by the network and to enforce much stronger media rights management. This enforcement could be carried by the ISP, directly within network elements, although it could be similarly undertaken by a DRM service provider. Nevertheless, it is not clear of how such implementation at network level would contribute to reduce DRM technology fragmentation and licensing issuing costs.

Since FMI hosts would not establish end-to-end connections, but rather communicate using data names, this would facilitate mobility of users between heterogeneous networks. With the increasing use of mobile devices, it becomes more and more common that users easily navigate between 3G or 4G networks and home networks, through WiFi, provided by different operators. But every time there is a handover between different networks, the connection to the host holding the content is lost, the established session is disconnected and the user experiences a 'service breakdown', reflected often in the video feed to be stalled for a few moments or in the need to restart the video. Since network elements would communicate referring to unique data names, this would overcome the need to know the content host address and would allow to retrieve the same content object from the closest location within the new operator's network, in a transparent way for the user. Although this requirement has not been mentioned by service providers, it largely contributes for an enhanced customer experience benefiting the perception of service quality and expectations with regards to a service provider as well as an ISP.

Requirements for accountability and traffic billing, although considered in FN requirements, have not been transposed to FMI. These issues remain unexplored in content-centric networking literature as well. Application development issues, streaming technologies and fragmentation of devices' operating systems which were mentioned by service providers as great bottlenecks in service provisioning have not been addressed in Future Media.

Finally, this chapter reveals that, and to answer RQ1, the requirements of the media sector are not being entirely accommodated in Future Internet perspectives. Several reasons can be pointed out. Firstly, the contributors to the standardisation activities and research activities overviewed in this chapter mainly come from academia and the telecom world, leaving out the media sector. Secondly, the real perspectives from the media sector do not appear to have been considered, although some views have been incorporated through market trends and traffic forecasts. Thirdly, this is also reflected in the work achieved and published by all these initiatives. The comparisons provided show that there are little differences between the postulated requirements and design goals of the different initiatives. In addition, it is also shown that Future Media requirements are focused on the network and IP level and did not aim to go beyond the technical requirements as envisioned by the seminal definitions of Future Network. Finally, was it because it was too centred on the technical underpinnings of the network that barely no media stakeholders have been involved in these activities? Or was it because there was a low participation of media stakeholders that requirements are too focused on the network level? All the media-related stakeholders interviewed in this study were not acquainted with the concept of Future Media Internet.

The following chapter will position online video services in Future Media Internet scenarios, considering that Future Internet capabilities will reach market deployment.

Chapter 7

Scenarios for Future Online Video Services

This chapter will address the last two steps of the methodology. In the previous chapters, the first three steps of the adopted methodology were conveyed. In the first step, online video services were analysed thoroughly — types of services, market, technology, revenue models —, and a generic value network was devised, as well as a taxonomy characterising the current state of online video services. Primarily based on issues raised by interviewees, the second step highlighted the positions of power exerted by several actors. These positions of power were translated into control points and they were discussed in terms of their properties and the dimensions of value network and functional architecture. With the help of the conceptualisation of gatekeeper roles, the third step put forward business model configurations centred on a number of actors and discussed the main dynamics of power in the current state of online video services.

Following up on the potential Future Media's technical, economic and social changes overviewed in the previous chapter, this chapter addresses the last two steps of the methodology. The future of online video services can be pictured as a mix of the Future Media vision and a number of technical, regulatory, business and social external factors which may disrupt the current state of the sector. In other words, all these factors constitute triggers, the external factors that may cause dynamic changes in business models (on the micro level) and changes in the industry's value network (on the macro level). Triggers may also affect the dynamics of control points, in particular on how these might change over time or on how the economic power they carry may transition to other states or actors.

The understanding of the dynamics of triggers is thus essential in guiding the last step of the methodology — to capture cause and effect of triggers in future scenarios. These scenarios, or different paths, will plausibly represent the evolution of the current value network of online video services and its multiple business model configurations. In this analysis, for each Future Media Internet scenario, the impact on gatekeeper roles and business model configurations will be studied.

Prior to the discussion on triggers, it is worth reflecting on the evidences presented in the previous chapters in light of techno-economic and innovation theories. With reference to Perez's techno-economic paradigm presented in Section 2.2, the current state of online video services demonstrates the existence of both technical and commercial feasibility in this exploratory stage. Despite technical improvements that could be achieved in the future, there have been continuous stimuli for firms, especially the established players, to innovate and build new offerings, while new entrants have benefited from low barriers to entry. The widespread of different services and supporting technologies has stimulated competition amongst players and shaped market demand and social behaviour towards the acceptance of online viewing. Right now, online video services are experiencing an explosive take-off and growth, as a critical mass willing to pay for these services is developing. Innovation is on a fast pace, with new services being launched, new models of content funding being experimented, and new devices and models of engagement embracing Internet connectivity being developed. Also, several firms are exploring verticalisation and service desintermediation strategies in order to conquer a market share of the online video hype. A single dominant platform or a dominant business model has not emerged yet. The following stage, which seems to be fast approaching, will see continued and accelerated growth and fast diffusion, leading to the maturity of a full constellation of services and technologies around online video. This process will be turbulent and shall see various waves of creative destruction, incurring in further transformations in the structure and interdependence of the media and ICT industries, as well as in shaping the business, regulatory and social context.

The next section discusses triggers which may contribute to a maturity stage or yet another evolution, while Section 7.2 depicts potential trajectories in the form of four Future Media Internet scenarios and analyses potential transitions in business model configurations and gatekeeper roles.

Section 7.3 draws some considerations for policy and regulatory intervention. Finally, this chapter will also tackle the remaining research questions:

(RQ2) Which factors may affect the dynamics of control and power positions between actors?

(RQ3) Which new business model configurations could emerge?

(RQ4) Which potential future policy and regulatory changes could help balance actors' relationships?

7.1 Triggers Influencing the Evolution of Online Video Services

Although the identification of triggers is exploratory in nature, it should be seen as discerning plausible factors, events and issues that may motivate changes to the control points (identified in Section 5.1) and their grouping into gatekeeper roles (Section 5.2). Therefore, the identified triggers constitute the answer to (RQ2). The triggers discussed below reflect potential evolutions of market trends, issues under discussion at regulatory and academic level, and factors raised by interviewees. They intend to take online video and its future as a whole and contemplate potential transitions in technology, business, regulation and social behaviour. Several technological triggers stem from and incorporate the requirements of Future Media Internet as foreseen by the standardisation (Section 6.3) and research initiatives (Section 6.4) reviewed in the previous chapter. Table 7.1 highlights the technological triggers (numbering refers to Table 7.2) which were derived from those initiatives. These technical capabilities contribute to a certain extent to the feasibility of a number of business and social triggers subsequently identified.

Table 7.2 summarises and guides the following discussion of regulatory, technological, business and social triggers.

The promise of "Anywhere, Anytime, Any Device" is currently almost realised but not entirely materialised on all devices available in the market. Online video service providers still have to overcome the complexities and incongruities of different devices and screen sizes, application requirements, and Internet access speeds. The current diversity of DRM solutions and streaming technologies limits online video services' value and user experience, as the solutions adopted by the online video service provider might not be supported by the end user's device. Similarly to the development cycle of other technologies, sooner or later, this fragmentation will be addressed by

Table 7.1: Technological triggers derived from Future Media Internet standardisation and research initiatives.

Future Media Internet initiatives	FMI Design Requirements	Technological Triggers
ISO/IEC 29181-6	• Support for any type of media content requiring different levels of QoS/QoE and various types of communications; • Differentiation at content level in order to enable a prioritised delivery based on media content; • Support for the identification of media content, media devices and user preferences; • Support for a wide range of devices able to consume or generate content and provide suitable media transport service; • Support for suitable delivery in terms of delay and reliability; • Inter-module information exchange and incorporation of QoS/QoE related information from different modules; • Content adaptation through different techniques; • Support for an adaptive and tailored container according to both content and network requirements; • Support for the adaptation of the dynamic characteristics of media according to content, network requirements, and user preferences; • Security at media level to ensure privacy and trustworthiness; • Support for heterogeneous devices as nodes of the network able to initiate, handle and finalise media content transmissions; • Simplicity, flexibility and scalability; • Seamless use of heterogeneous network environments and mobility of users along different networks and attachments.	2. DRM can be enforced at network level; 4. Continuity of user activity across multiple screens; 5. Second-screen applications interconnected with online video services; 7. Personalised/context-aware experience and content recommendations; 9. Enhanced, customisable quality of service and experience, and delivery prioritisation for real time and low delay video transmissions; 10. Seamless mobility between heterogeneous networks.
ITU-T Y.3033	• Support for name based communication, routing of a data object in the network is done by name and not IP address; • Incorporate security mechanisms to allow a user to verify the validity and integrity of a data object; • End hosts should be able to communicate without establishing an end-to-end connection, thus simplifying mobility of end terminals; • Support for in the network caching mechanisms; • Support for APIs for data object distribution and retrieval from the network; • Support for receiver driven transport and sender driven transport.	2. DRM can be enforced at network level; 4. Continuity of user activity across multiple screens; 7. Personalised/context-aware experience and content recommendations; 8. Content is cached in the network and can be retrieved from the closest user location; 9. Enhanced, customisable quality of service and experience, and delivery prioritisation for real time and low delay video transmissions; 10. Seamless mobility between heterogeneous networks.
FCN group	• Design for tussle: flexible content business models; • Accountability of network resource usage at content level; • Content and context-aware network based capabilities for media content; • Support for end-to-end data Gbps and edge based content distribution; • Context-sensitive and real-time personalisation of content according to the user context, network topology and user terminal.	4. Continuity of user activity across multiple screens; 5. Second-screen applications interconnected with online video services; 7. Personalised/context-aware experience and content recommendations; 9. Enhanced, customisable quality of service and experience, and delivery prioritisation for real time and low delay video transmissions; 10. Seamless mobility between heterogeneous networks.
FMI-Task Force	• Scalable multimedia compression; • Network coding and streaming; • Content and context fusion; • 3D content generation leveraging emerging acquisition channels; • Immersive multimedia experiences; • Multimedia, multimodal and deformable objects search; • Content with memory and behaviour.	4. Continuity of user activity across multiple screens; 5. Second-screen applications interconnected with online video services; 6. Emergence of immersive real-time experiences for online video consumption; 7. Personalised/context-aware experience and content recommendations; 10. Seamless mobility between heterogeneous networks.

way of two potentials trajectories: the emergence of *de facto*[1] standards for DRM and streaming or the agreement on the adoption of *de jure*[2] standards *(technological triggers 1 and 3)*. While MPEG-DASH adoption is already underway and will potentially overcome the market share of Apple,

[1] *De facto* standards are widely accepted and used in the market but do not need formal approval from a recognised standards organisation. In general, the *de facto* standard is the result of a widespread consensus on a particular product or protocol with a large market share.

[2] *De jure* standards are promulgated by official regulatory agencies such as a government, or a domestic or international standard body, such as ITU and ISO.

Table 7.2: Summary of regulatory, technological, business and social triggers.

Regulatory	**Technological**	**Business**	**Social**
1. Erosion of mobile data caps; 2. In Europe, quotas for the amount of European content in online video services may be established ensuring cultural obligations and diversity; 3. Online video service providers called to contribute to national content funding in the countries where services are provided; 4. Rules for agreements between CDNs/online video service providers and ISPs; 5. Rules for content delivery prioritisation at network level; 6. Rules for content aggregation and recommendations ensuring that certain content is not prioritised over other; 7. Online video services can be accessed by consumers in other countries where the services are established; 8. Simplification of content licencing processes; 9. Rules to ensure access to cultural heritage content; 10. Privacy regulation may also cover online video services.	1. DRM technologies will persist and converge into a few accepted standards; 2. DRM can be enforced at network level; 3. Streaming technologies converge into a few accepted standards; 4. Continuity of user activity across multiple screens; 5. Second-screen applications interconnected with online video services; 6. Emergence of immersive real-time experiences for online video consumption; 7. Personalised/context-aware experience and content recommendations; 8. Content is cached in the network and can be retrieved from the closest user location; 9. Enhanced, customisable quality of service and experience, and delivery prioritisation for real time and low delay video transmissions; 10. Seamless mobility between heterogeneous networks; 11. 4K and 8K standards and related technology are widely adopted in the market.	1. Legal services compete with illegal services: EST versus SVOD versus pirate content; 2. ISPs, pay-TV providers, mobile operators launch their online video services versus establish partnerships and alliances with other online video service providers; 3. Personalised ads tailored to consumer preferences and context; 4. Market adoption of proprietary versus open technologies; 5. New models of content creation funding; 6. Content release windows will adapt as online video services' original content production expands; 7. New metrics and tools for online video services audience measurement across multiple screens and devices.	1. Users favour legal video consumption; 2. High acceptance rate of online video services; 3. Users favour a personalised experience and control over the content they want to watch and when want to watch; 4. Live versus on demand content consumption; 5. Physical ownership versus digital ownership versus online streaming; 6. High penetration of various types of mobile and connected CE devices and high-definition TV sets.

Microsoft and Adobe's proprietary technologies, the outcome for DRM seems to depend on the adoption[3] of a *de facto* standard. Compared to streaming, the current ecosystem for DRM is more closed, dominated by industry proprietary technologies and showing little signs of *de jure* standard's diffusion. One way or another, market forces will put pressure on the convergence towards one or a few dominant standards *(business trigger 4)*. On the one hand, it is rather improbable that CE vendors will support a multitude of standards in devices and, on the other hand, also unlikely that online video service providers will persist on devoting so much effort in developing several versions of the same application in order to support multiple devices.

Although there are already initial efforts, current online video applications are not really

[3] It is hard to believe that, in the near future, rights holders associations like the Motion Picture Association of America (MPAA) would quit their efforts in controlling how content is circulated and in locking content behind technological solutions. Therefore, it is assumed as rather unlikely that DRM will be removed from video, as rights holders will continuously exercise market pressures by only licencing content to online video service providers that can guarantee that content is rightly locked. But as service providers develop a strong brand and service, grow a large customer base and become gatekeepers for content distribution this condition can actually change. That was what happened in the music industry in 2009 when Apple announced that all songs acquired through iTunes would be DRM free. But this also meant that consumers got more tied to Apple's walled garden, as songs acquired on iTunes could only be played in iTunes, which is only available for Apple's operating systems and Microsoft Windows.

designed to reach a single user across multiple screens. Having a cross-screen view of consumer activity would allow a consumer to start watching a film on a connected TV and continue to watch that film a day later on a tablet on the way to work[4] *(technological trigger 4)*. Viewers' quality of experience would be improved and many would not churn to competing services. A cross-screen perspective of viewer's activity would also allow online video service providers to supply advertisers with data to better tailor ads to the preferences and context (e.g. time of the day, using WiFi or mobile broadband, etc.) of viewers, invest in more appealing ad formats, and benefit from additional sources of revenue *(business trigger 3)*. Furthermore, having a cross-screen view would enable second-screen services to enhance interaction and better translate the user behaviour into multiple interrelated contexts *(technological trigger 5)*. Interactions with social networks are also expected to be further developed, allowing viewers to socialise around video content. Also likely to emerge are immersive real-time experiences which would combine professional content and enriched 3D/virtual worlds, exploring user's engagement and personal senses *(technological trigger 6)*. Despite all these potential features, it is crucial to think the strategy for online video services as more than a mere duplication of linear TV and plan on investing in user experience improvements. Similarly to music streaming or e-commerce services, online video services need to evolve to deliver a personalised and interactive entertainment experience that reflects not only user behaviour, but also user and network contexts, while lowering consumers' search costs by directly suggesting content they are likely to watch *(technological trigger 7)*. Nonetheless, regulatory safeguards may be needed to ensure certain content is not prioritised or penalised over other in search queries or in (personalised) content recommendations *(regulatory trigger 6)*.

As consumers are increasingly demonstrating willingness to take control of their online activities, they would favour a service that allows viewers to personalise their experience, to control the streams they want to watch from their preferred sources, at their preferred times of the day, that knows the time of the day the viewer better tolerates advertising, that notifies about new content when the viewer is at home, but not when the viewer is commuting to work on a mobile broadband, and many other potential features *(social trigger 3)*. These are all potential enhancing features that can be supported by big data and machine learning techniques[5] in order to realise an enhanced user

[4] Netflix applications already allow viewers to do this.

[5] A preliminary incursion into these features is Amazon's ASAP (Advanced Streaming and Prediction) available on Fire TV and Fire TV Stick, which learns about the films the viewer watches and then recommends new films based on those preferences.

experience.

As some of the respondents in the study acknowledged, online video of the future will be more about user experience than just content *per se*. After Bill Gate's 'Content is King'[6], followed by the discordant Odlyzko's argument advocating for 'Connectivity is King' (Odlyzko, 2001), has the time for 'User experience is King' arrived? Of course viewers will still value content, but at some point, all services will converge in terms of catalogue and exclusive content will no longer be differentiating enough. Therefore, the combination of content with a multiscreen, personalised, immersive experience will be compelling and differentiating features amongst services *(social trigger 2)*.

With this level of user experience and a service that "understands the viewer's needs", viewers would favour innovation and convenience in finding content in a single place over the frustration[7] of using multiple services, applications and devices to watch their preferred content. On these terms, consumers would favour legal video consumption *(social trigger 1)*. In fact, at least for music and over the past years, the existence of legal[8] streaming services with rich catalogues has made consumers less likely to download illegal content (McChesney, 2013). However, it can be assumed that viewers would still turn to illegal networks whenever they cannot find the content they are willing to watch. In the case of online video, the high popularity of 'illegal' applications such as Popcorn Time seems to result from their friendly user experience and a rich catalogue featuring the latest film and TV series releases, all in one place *(business trigger 1)*. This leads us to highlight that not only technological features limit the user experience, but in fact, the media (film and television) industry has long lived on a business model characterised by artificial or temporary forms of scarcity in order to increase content value by controlling when and how one can watch video content through release windows and geo-blocking. But we are currently witnessing new entrants in the media sector, such as Netflix, attacking licencing terms, timing of windows and content exclusivity. Plus, in order to stand out from the competition and hold attractive content, new players have also been investing in original content production. Furthermore, players such as Hulu

[6]Bill Gate's 1996 essay is available at Bailey (2010).

[7]The frustration over finding the content one wants to watch has lead to the creation of U.S. websites such as Leanflix or Can I Stream.it?, which allow to search for a film title and find the services which have the film available for streaming or downloading, in subscription, rental or purchase modes. The French government agency for the audiovisual, Centre National du Cinéma et de l'image animée (CNC), has also created a website (http://vad.cnc.fr) to find films available in online video services in the French market.

[8]Of course the legal alternatives also come at the expense of locking-in consumers in closed proprietary systems.

and Amazon have established specific programs for content funding, funding directly creatives and content producers, while guaranteeing exclusive rights for content distribution. Content creators and producers are also exploring other forms of content funding and self-distribution strategies, via crowdfunding and new platforms where pilots can be showcased, such as ScreenHits. As online video players embark further on original content production and new models of content funding disseminate amongst content creators and producers, rights holders will feel compelled to adjust release windows and try new models of making content available in online video services in order to sell their own content at high prices *(business triggers 5 and 6)*.

As digital distribution still perpetuates the same models of physical distribution regarding rights management, and even showing signs of increased complexity with several licencing rights models specifically set for online video services' revenue models, simpler licencing rules for digital services may be suggested through regulatory proposals *(regulatory trigger 8)*. This would potentially allow for the convergence between linear and non-linear video services. Furthermore, one would expect that a consumer acquiring a service subscription in one country, would be able to use the service in another country where the same service is established *(regulatory trigger 7)*.

Potentially, at social level, new perspectives on individualised and democratised content consumption are needed. Youngsters are said to like to control what they watch and prefer binge watching, but eventually older generations will also accept[9] these new consumption options offered by online video services. And before the feared cord-cutting strikes in, a possible approach to counteract it is to offer *à la carte* channel subscription. Online video services should not be seen as substitutes for TV watching or going to the theatre for film watching, neither on demand content will replace a live football match *(social trigger 4)*. All these consumption modes will have people's acceptance and correspond to different modes of experiencing media and should be regarded as part of the future of media. The same applies to which will be the preferred device to watch video content. Will the TV-set be replaced by tablets? Perhaps not. Perhaps consumers will still value all these devices for the convenience they carry in different contexts and personal moods *(social trigger 6)*. That is not to say that the penetration of various types of mobile and connected CE devices will not increase. On the contrary, all market research reports point to that it will, but people will also be fascinated by new TV-sets' curved screens and 4K and 8K's high definition

[9] E-services adoption may in fact contribute to general acceptance of online video services amongst older generations.

image *(technological trigger 11)*. However, in the future, perhaps consumers will feel less need to own physical copies of films, such as DVDs or Blu-rays *(social trigger 5)*. In the case of music, market reports show that owning physical CDs and digital copies of music albums is in decline, while subscription-based music streaming is significantly growing (Nielsen, 2015). However, as data caps in mobile plans are slowly replaced by usage-based or flat-rate plans, smartphones may become one of the preferred devices to watch content during a work day, while commuting, having lunch or taking a break. In a recent study, Odlyzko et al. (2012) concluded that consumers have a surprisingly strong preference for flat-rate billing, since many consumers were willing to pay a premium fee to avoid worrying about whether they were reaching the consumption limits of a subscription with data caps *(regulatory trigger 1)*.

Enhanced Internet connectivity, mobility and quality of service will also be critical, with specific requirements for video involving high bandwidth, real time and low delay transmissions. The network layer will have to guarantee that there is no delay beyond a certain threshold in the transmission of video content. Technical advancements tackled in on-going research are expected to deliver the required features for QoS and QoE adaptation for content delivery according to traffic status, network capacity, content demand, user context and user devices. This would allow ISPs and network operators to customise QoS and prioritise content delivery to their benefit or in service providers' benefit *(technological trigger 9 and 10)*.

In addition, content location and security would enhance online video services experience. Future Media networks would allow for content to be cached directly in network nodes facilitating retrieval and delivery of content from a network node closer to the user location *(technological trigger 8)*. Furthermore, at security level, DRM could be enforced on media files directly within network elements and carried by ISPs or network operators, thus removing that burden from online video service providers *(regulatory trigger 2)*.

To differentiate services on the basis of video-specific QoS implies that ISPs and telecom operators would have enough incentives to make the necessary investments in network infrastructure and management. Since new technology features would easily facilitate QoS customisation and traffic prioritisation, these players may feel compelled to differentiate traffic based on content type or content provider in order to seize a share of online video services' revenue. We would expect these players to charge online video service providers and CDNs for preferential treatment of the video traffic traversing their networks. However, potential rules may be needed to regulate content delivery prioritisation at network level in order to ensure users' service access is not hindered and to protect competition between small and big online service providers, the latter having considerable financial capacity to engage in preferential treatment agreements *(regulatory trigger 5)*. In addition, the agreements between ISPs and CDNs may need to be regulated or perhaps just be more transparent, to avoid abuses of dominant market positions and ensure competition between small and big players is not curtailed *(regulatory trigger 4)*. In order to recover the technological investments, ISPs can also feel compelled to launch and integrate online video services in their broadband/pay-TV bundles or to partner with an online video service provider. In the latter case, ISPs would trade better (network) quality of service for a percentage of the online video service provider's revenue (e.g. on the basis of consumer subscriptions or on the traffic traversing their networks) *(business trigger 2)*.

The triggers identified so far are mostly of technological, business and social nature. Regulatory triggers may also be suggested, although at such early stage of technology/market development, institutions normally choose to let the free market rules dominate and the market regulate itself in order to avoid hampering innovation. Nevertheless, for online video services, there are a number of issues raised by interviewees and under discussion in European fora[10] that are worth mentioning as they could be considered for regulation in the near future.

First, there is a risk of unfair competition between services offering linear content ('TV-like' content) and services offering non-linear content, such as VOD. As two interviewees mentioned, broadcasters are subject to a number of obligations that 'new' media players are not. In Europe, linear services are subject to a stringent regulatory framework defining obligations related with, among others, protection of minors, protection of European works, advertising limits, contribution to national content funding *(regulatory trigger 2)*.

Second, non-European players providing media services in Europe are not obliged to the same rules regarding service provision. The European AVMS directive (EC, 2010) is based on the 'country of origin' principle, whereby audiovisual media service providers are subject to the regulations in their country of origin only, and are not obliged to comply with the regulation in the destination country. Interviewees mentioned that this principle allows global players to circumvent

[10] Discussions can be easily followed through Nordicom's European Media Policy newsletters available at http://www.nordicom.gu.se/en/media-trends/media-trends-newsletters

national regulation and taxation in European countries, creating a discriminatory market effect for European players and innovation. For these reasons, regulatory updates may be considered to create a level playing field for both broadcast and online video services, amongst European and non-European based stakeholders, ensuring that players are subject to the same rules, for example, in what concerns cultural obligations, pluralism and diversity, as well as taxation and content funding contributions, in the countries where services are provided *(regulatory trigger 3)*.

Third, consumers' data protection and privacy must also be ensured in online video services independently of the provider's country of origin or the country where the service is being provided. A regulatory framework that sets a level-playing field and harmonised set of rules may be needed to ensure online video consumers' privacy is protected using this type of digital services *(regulatory trigger 10)*.

Finally, as a privileged channel to reach a wide and diverse audience, online video services should also promote and distribute cultural heritage content *(regulatory trigger 9)*. This incentive could be part of the cultural obligations rules including online video services. Other regulatory actions could also be required to ensure that cultural works with unclear rights holders and orphan works could be considered cultural heritage and be released for digital distribution under certain conditions.

These triggers provide the answer to (RQ2), as in the regulatory, technological, business and social factors which may affect the dynamics of power and control over time and with the ability to influence different actors. For this reason, the identified triggers (summarised in Table 7.2) are considered as input to the upcoming task of scenario definition.

7.2 Online Video Future Media Internet Scenarios

Rather than using traditional scenario planning, relying mostly on developing narratives (sometimes based on a number of uncertainty factors) followed by describing key drivers and success factors (Varum and Melo, 2010), the approach taken in this study explored first the importance and impact of the triggers identified in the previous section. These triggers were used to choose the uncertainty factors and develop an impression about the significance of the uncertainty factors to multiple actors and their impact on the future development of online video services. This approach results from an intersection between the methodologies proposed by Battistella et al. (2013) and Pateli and Giaglis (2005).

Based on an empirical analysis of the triggers, taking into consideration views expressed in the interviews and industry and academic forecasts about potential sector transitions, these triggers were positioned in two dimensions subject to an assessment of their importance to business actors and their potential impact on the future development of online video services. This analysis was guided by the following questions:

- Which actors will care[11] for the transitions arising from this trigger?
- Which impact[12] will this trigger generate in the development of online video services?

The outcome of this analysis is presented in Figure 7.1.

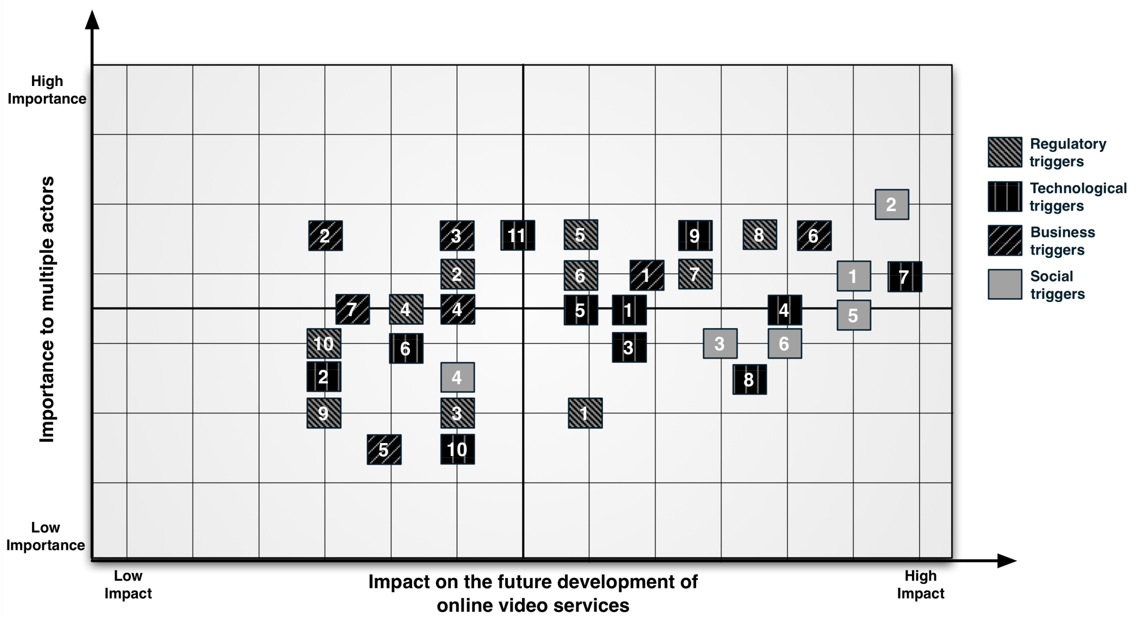


Figure 7.1: Mapping of triggers over importance to multiple actors and impact on the future development of online video services.

The triggers representing simultaneously the highest importance and the highest impact which are singled out are:

- High acceptance rate of online video services (social);

[11] As in, for which actors will their businesses and services be influenced in any way because of this trigger. Annex B provides the empirical results of this analysis for each trigger.

[12] Impact means any kind of transition from the current state to any other state. For instance, an increase in user adoption, changes to pricing and business models, positioning of actors, etc.

- Personalised/context-aware experience and content recommendations (technological);
- Users favour legal video consumption (social);
- Content release windows will adapt as online video services' original content production expands (business);
- Simplification of content licencing processes (regulatory).

These five triggers provide a foundation for analysis but still leave ample room for uncertainty. In order to drill down these triggers into two uncertainty dimensions, a combination of the triggers with Future Media Internet research results moving to the market, suggests two main dimensions through which to envision the future of online video services:

- Will content licencing processes for online video services be softened, with no differentiation between content and release windows across licencing rights models, or will they be intensified?
- Will capabilities such as customisable QoS and support for context awareness for media content services lie at network level (in-the-network adaptation) or at device level?

The first dimension is derived directly from the triggers, while the second puts in perspective a major technical limitation of the current Internet which would be overcome with FMI developments.

Content licencing models: softened or intensified?

As already described in Section 5.1, licencing rights models vary across physical (theatrical, DVD, Blu-ray), (premium) TV broadcast and online distribution. But also within online distribution. Transactional-based online video services have shorter release windows than subscription or ad-based online video services. In addition, broadcasting rights do not include by default rights for TV Everywhere or catch-up distribution. Players providing services in different countries also have to negotiate and acquire rights for each country according to the territoriality principle. Essentially, these licencing practices not only create bottlenecks for online video service providers, since they allow some services to achieve competitive advantage over others, but also considerably affect the accessibility and diversity of content across services from a consumer's point of view.

Up to now we have seen rights holders and content producers dictate the terms and conditions of content rights models and release windows. As observed from the interviews, some players think these terms provide a guarantee for rights holders business models and content production funding, while other players advocate for simpler rules to allow for convergence between linear and non-linear video services and to achieve a level playing field. Interviewees also acknowledged that, for instance, release windows have been changing and softened over the last years satisfying the pressure imposed by consumer demand. In the future, will consumer demand for online video services and pressures within the sector drive content licensing processes to become softer? Or will lighter processes be imposed by national, European[13] or global regulation? Or, alternatively, in an attempt to fight for the survivability of physical distribution channels and to guarantee content funding, will rights holders and content producers aggravate the licencing rules for online video services?

Customisable QoS and context awareness for media content services: at network or device level?

Seen the growing consumption of online video, Future Internet and Future Media Internet research and standardisation activities advocate for the next generation of media and personalised content services, catering for efficient handling, delivery, presentation and protection of content (as described in Chapter 6). Unlike in the current paradigm, in which communication is established point to point, in future networks, content would be kept in the network itself. Therefore, for the transmission of media content, the network layer would guarantee transmission delays do not surpass certain thresholds, so that user experience is not hindered. High bandwidth, real-time, low delay transmission, in-the-network adaptation are required capabilities for the transmission of media content. Hence, future networks would provide support for customisable QoS from user and/or application perspectives along with support for service composition and context awareness, accommodating any kind of media services with a wide variety of traffic characteristics and behaviours. However, as of today, an user or application cannot request a specific set of QoS guarantees in an end-to-end manner, since the QoS of a particular flow along a path depends on how every single node treats its packets. These nodes are almost always detained and managed by different administrative entities so only with the coordinated action of every autonomous system could globally guaranteed resources be achieved in today's Internet. As a remedy, current available

[13]The European Commission has just presented a 'Digital Single Market' strategy advocating for, among others, a modernisation of the current's copyright system, to reduce differences between national copyright regimes and allow for wider online access to content across the EU (EC, 2015a).

overlay protocols for media services (such as MPEG-DASH) provide content adaptations in accordance with user's context awareness at the device level. For example, this device side adaptive behaviour would provide a lower video resolution in case the user is using a wifi network rather than a fixed broadband network, as an attempt to overcome current Internet's lack of end-to-end QoS guarantees.

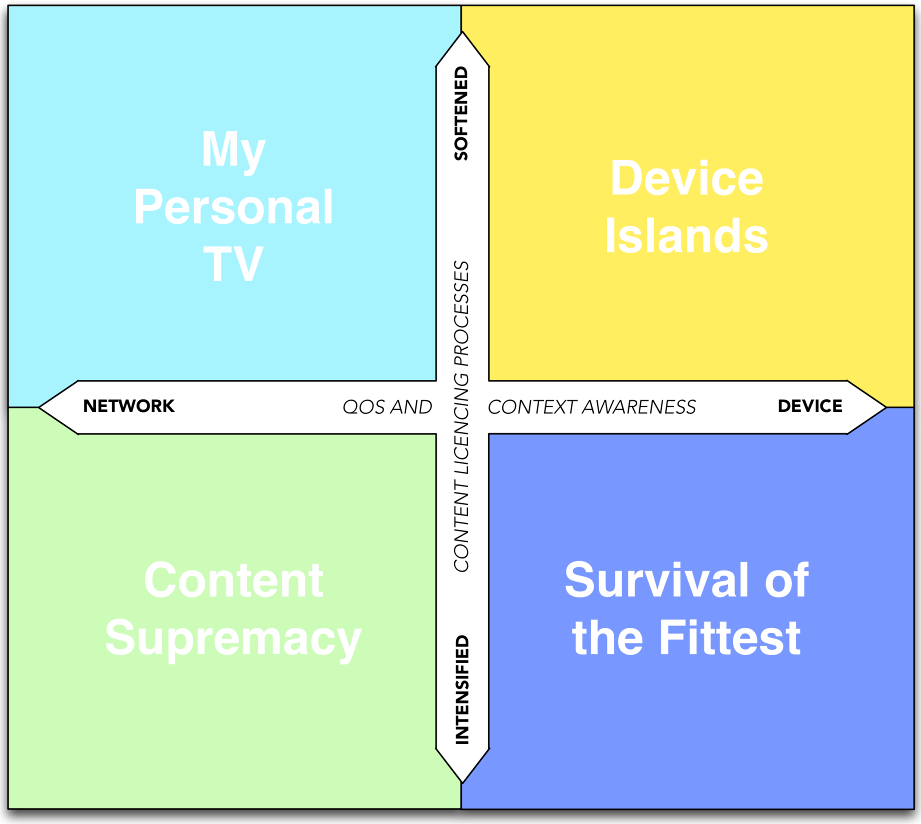


Figure 7.2: The structure of the four Future Media Internet scenarios.

These two lines of uncertainty lead to four possible Future Media Internet scenarios represented in Figure 7.2: (1) Survival of the Fittest; (2) Content Supremacy; (3) Device Islands; and (4) My Personal TV. In the following subsections, each hypothetical scenario description provides an overview of the dynamics of the future market and the services' characteristics. For each Future Media Internet scenario, a discussion of the potential changes to the business model configurations and gatekeeper roles presented in Section 5.2 is also provided. Unlike other scenario planning exercises, a predefined time horizon is not set for this scenario definition. While a long time horizon could be considered, technology rollouts could start between 2015 and 2020, as put forward by the standardisation bodies and the research work overviewed in the previous chapter. Finally, the

Future Media Internet scenarios presented in the following subsections assume that online video services are well accepted amongst consumers and these prefer to consume legal content instead of pirate content.

7.2.1 Survival of the Fittest

This scenario is the most similar to the current market and technology status. However, due to more strict content licencing processes, business stakeholders with services in multiple countries see their value networks becoming even more fragmented across geographies, pricing models and types of content. The playground looks like an all against all battlefield, with the different actors trying to conquer a stake of the market, fighting for the most attractive/demanding content or financing the production of exclusive content. In this scenario, there is no room for niche players — firms need to have the financial capacity either to afford the investments in licencing content for multiple platforms and countries or to finance original and exclusive content.

Consumers need to establish relationships with multiple stakeholders in order to consume the content they want. As business agreements for exclusive content between rights holders and online video service providers change frequently, consumers also need to establish relationships with new providers in order to keep watching their favourite content. A lack of common standards and interoperability across devices, DRM and content formats, results in users' frustration over services' quality of experience. Although online video services have introduced immersive experiences and the possibility to continue watching the same content in different screens/devices, in practice, most consumers are unable to try out these features due to the lack of interoperability.

Overall, consumers feel frustrated in using multiple services and the market is dominated by a number of big players from different industry sectors, which make considerable investments to secure the most popular content.

In this scenario, content development, rights management and content aggregation are the main gatekeeper roles. Every business model configuration previously introduced is still valid. The business model configurations centred on online video aggregators, CE vendors, Internet players, pay-TV operators, and broadcasters develop their value propositions on securing a differentiating and exclusive content catalogue through partnerships with content producers and rights holders or through M&As between relevant players dealing with content production and licencing.

Business model configurations centred on content producers and rights holders have the potential to lead the market as these actors control the main gatekeeper role, but may not be at the forefront of technology adoption and will hence struggle to establish partnerships with software, OS and CE vendors. For these reasons, the quality of experience of the services provided by these actors may be low and hence these services are prone to gain little consumer traction.

7.2.2 Content Supremacy

In this scenario, rights holders and content producers get on board the technology bandwagon in order to establish direct customer relationships and deliver an enhanced user experience, while dictating stricter conditions for other actors to acquire content rights. They leverage on their control position and the vast amounts of content (and archived content) they possess to deliver services with a differentiated and compelling content catalogue with no billing intermediaries. They also establish alliances and partnerships with other rights holders and content producers to strengthen the content offer in their services and share content amongst the various services. Some players leverage on their catalogue of niche content, while others with an international or global presence, leverage on their brand recognition to grow their customer base. In addition, these players create a new type of exploitation window in order to achieve competitive advantage — this new window prioritises content releases for their own online video services. After a certain period, that content is made available to online video services held by other actors. Ultimately, rights holders and content producers compete and cooperate (coopete) with each other for a share of the online video services' market.

From a user perspective, these actors build their offer around the experience of the one-stop shop — consumers can access all types of content in one place and benefit from earlier content releases and high quality of experience, compared to other online video services. In order to guarantee superior QoS with image quality delivery tailored to the user context and demand, rights holders and content producers establish partnerships with network operators and ISPs. With access to the adaptation of content delivery to the users' context, content producers and rights holders can also measure content impact and get information about users' interactions (e.g. content search or content skips). They are able to build further on the customer relationship and build channels to obtain specific user feedback, for instance, about a particular series' episode, as well as tailor ads to the consumers' preferences. These new levels of engagement allow for the wide spread of new content production techniques (e.g. 3D and immersive stories) as well as new experiences with content releases, e.g. simultaneous theatrical and global streaming releases. In general, these services are easy to use, deliver a number of new features as well as the content consumers want to watch, meeting consumers' service quality expectations.

Furthermore, in this scenario, ISPs control the network assets for content storage and delivery and, as part of partnerships, they charge content producers and rights holders a percentage over the services' video traffic transmitted over their networks. Depending on the terms of the partnership and the size of the stakeholder involved, an ISP may choose to charge differently for the traffic transmitted or differentiate traffic amongst stakeholders/online video services. ISPs justify these charges as the means to compensate for the investments in upgrading their broadband networks, which became fit for video content delivery with guaranteed high quality of service.

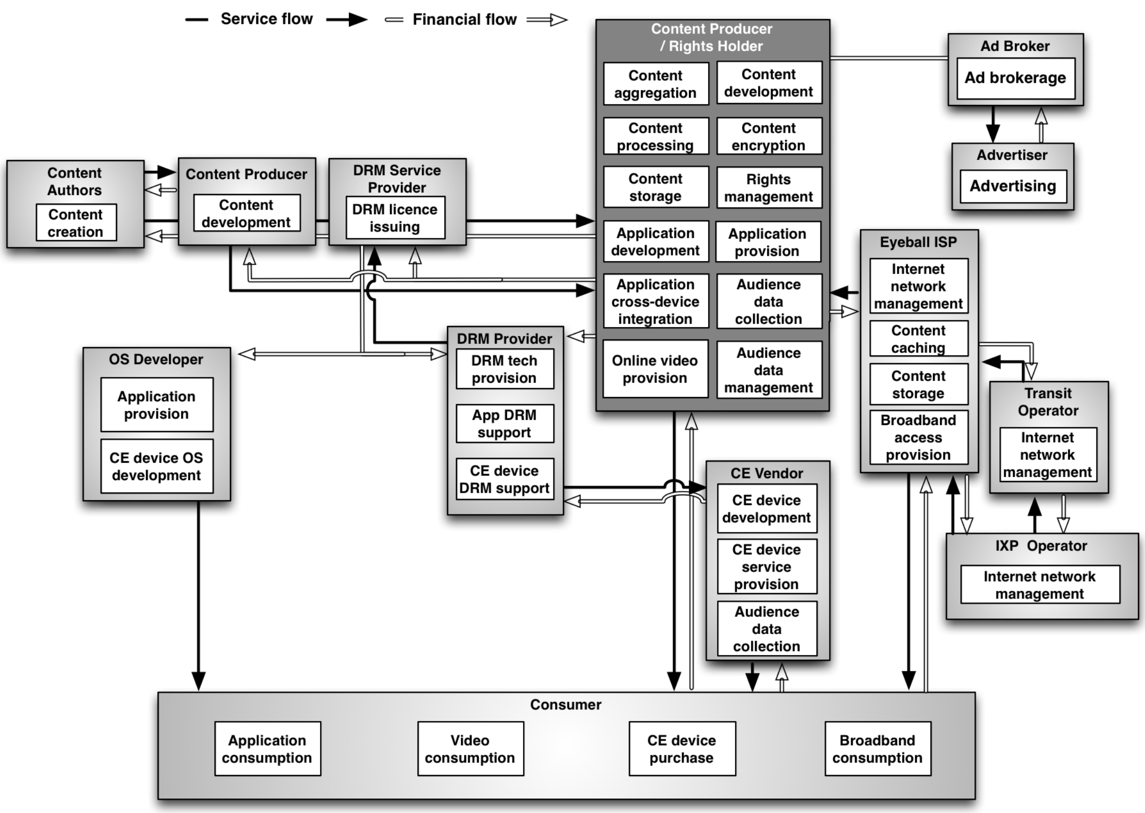


Figure 7.3: Business model configuration characterising Content Supremacy scenario.

In this scenario, content development and rights management are again the main gatekeeper roles. By conducting anti-competitive practices related with exploitation windows and holding back content to their benefit, content producers and rights holders completely control the aforementioned gatekeeper roles and content aggregation, thus creating imbalances to content access and licencing towards other actors, and consequently, on online video services development and competition.

The business model configuration centred on content producers and rights holders previously presented could generally still hold. However, in case these actors would also incorporate software and technology related activities as part of their online video services development, they would also control the gatekeeper roles of service cross-device integration, service provision and billing, and audience management. Content storage and delivery would still be controlled by an ISP, which would have already deployed Future Media Internet related technologies. The business model configuration could evolve to the model shown in Figure 7.3.

7.2.3 Device Islands

In this scenario, rights holders gradually relax content licencing processes, experimenting with simultaneous availability of films on theatres and on online platforms at global scale, and exploring new financing and revenue sharing models. As the offer for legal content across different online video services becomes more attractive, consumers feel compelled to watch live and on demand content from legal services. However, to consumers' dismay, content demand drives bandwidth problems and magnifies the lack of quality of service.

Facing this trend, CE vendors leverage on their installed device base and their proprietary standards to strengthen their position as content aggregators and billing intermediaries. CE vendors work on improving proprietary streaming technologies and protocols to tailor video content to the user context while improving end-user QoS through content caching and delivery networks dedicated to their online video services. Moreover, as global players, they have the ability to negotiate content rights at a global scale. Through exclusive deals with rights holders they build closed ecosystems characterised by content tied to the vendors' devices. With technology that optimises and ties content delivery to vendors' devices, together with the control of the value network, CE vendors provide an integrated and stable experience, with satisfiable quality from the consumer's point of view.

As a consequence, online video services propositions concentrate on a limited number of big CE vendors with closed ecosystems and several revenue models, such as SVOD and TVOD. However, there is no interoperability between services, which means that content acquired in a service cannot be played in another service. Devices with immersive (e.g. virtual reality) and 3D capabilities become mainstream, as there is a wide range of content available. CE vendors partner with content producers to specifically produce content with interactive features tailored to their devices right from the start. Thus, these services rely on a tight coupling between hardware, software and content.

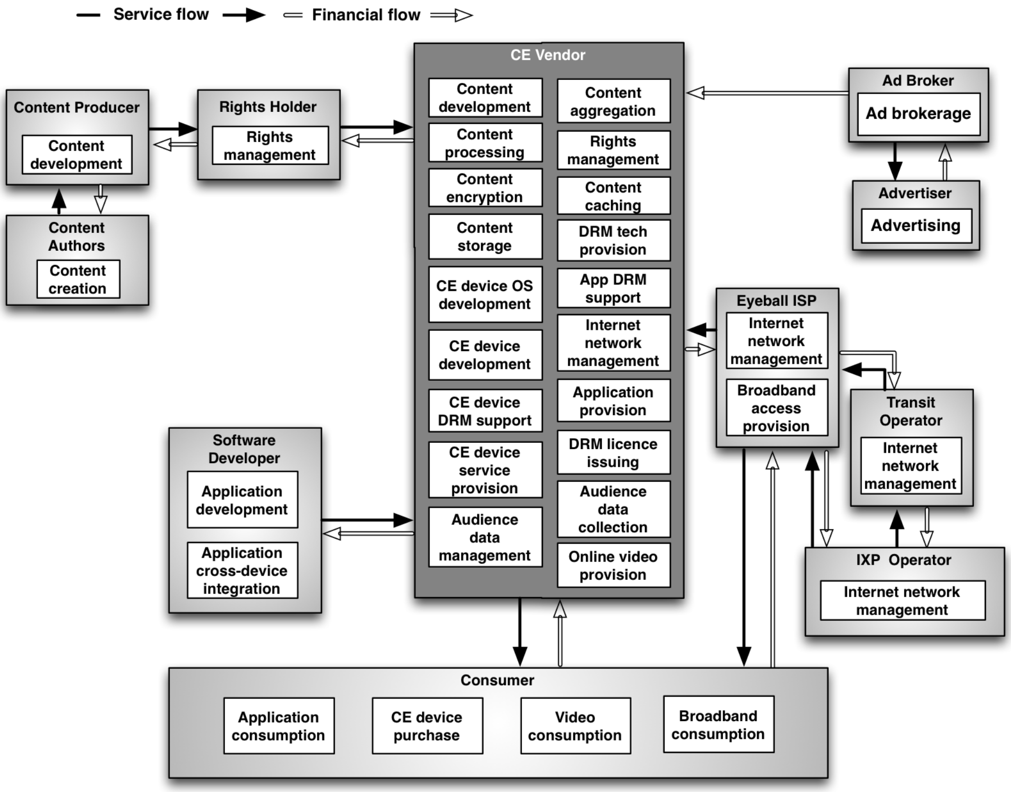


Figure 7.4: Business model configuration characterising Device Islands scenario.

In this scenario, CE vendors hold control of most gatekeeper roles. Only content development and rights management roles are still controlled by content producers and rights holders, but are largely influenced by CE vendors partnerships and funding agreements. All technology and device development activities are controlled by CE vendors, as well as content aggregation, storage and caching. Peering and transit agreements with eyeball ISPs allow CE vendors to interconnect their own content networks to reach consumer delivery. The future business model configuration for this scenario is to a great extent similar to the business model currently being pursued by Internet Players, such as Google or Apple (as presented in Subsection 5.2.4). Compared to Internet Players, CE vendors such as Sony and Samsung are in an advantageous position as they are strong brands in the market for personal (smartphones and tablets) and home entertainment (TV sets, game consoles, media players) CE devices. The corresponding business model configuration is shown in Figure 7.4.

7.2.4 My Personal TV

In this scenario, pay-TV operators leverage on their strong brand recognition, large customer base, direct customer ownership and control of network resources. Pay-TV operators deploy future media networks guaranteeing support for customisable QoS from network, user and/or application perspectives along with support for service composition and context awareness, accommodating any kind of media services with a wide variety of traffic characteristics and behaviours. Through future media networks, pay-TV operators can offer context-sensitive content services, optimise the personalisation of content in real-time, adjust network- and terminal-awareness according to the user context and adapt the configuration of network protocols and network topology to respond to the services' needs.

From a user perspective, the deployed infrastructure allows pay-TV operators to provide an integrated service with a seamless experience across linear and non-linear content, fixed and mobile broadband, and across screens. On top of that, pay-TV operators deliver content services with a multi-screen approach, with 3D and immersive content, a personalised experience, meeting users' expectations. While subscribing a quadruple or quintuple service package from a single provider, the consumer has access to a multitude of content and can choose when, where, in which device, and which content to consume. This allows consumers to build a personal service, configuring and choosing content for individual playlists for different occasions, locations and devices, with seamless transitions of the viewing experience across devices and environments. Although consumers become locked in a pay-TV operator walled garden, the great majority of them does not feel threatened as they value more the ability to build a personalised content playlist. Furthermore, consumers feel they are getting the best out of the service they are paying for — a service that always delivers the best quality of experience.

Contrastingly with the walled garden established for consumers, pay-TV operators offer rights holders and content producers an open platform where they can publish their content and choose their preferred revenue model as well as to decide on releasing content in an exclusive manner or ahead of release time with regards to other platforms or media supports. Similarly to an App Store model (Gonçalves et al., 2010), pay-TV operators keep a percentage of the revenue generated by the content and share the remaining revenue with rights holders and content producers. Via this platform, rights holders and content producers are also given the possibility to measure content impact and get fine-grained information about users' interactions (e.g. pause, rewind and fast forward actions, searches, viewing times, device information) and audience metrics allowing for an exploration of alternative routes for content production. Application developers can also contribute to this platform with apps (e.g. games, second-screen apps) which enrich consumer experience, while earning a percentage of the revenue generated by the apps. Depending on the chosen revenue model, exclusivity and the popularity gained over a period of time, content and apps may be served differently, either with different types of quality (for content), either by showing up more or less in search results and user recommendations. For instance, content released exclusively and with a high revenue rate for the pay-TV operator, may be served with more quality and be recommended more often, than non-exclusive content with a low revenue sharing rate.

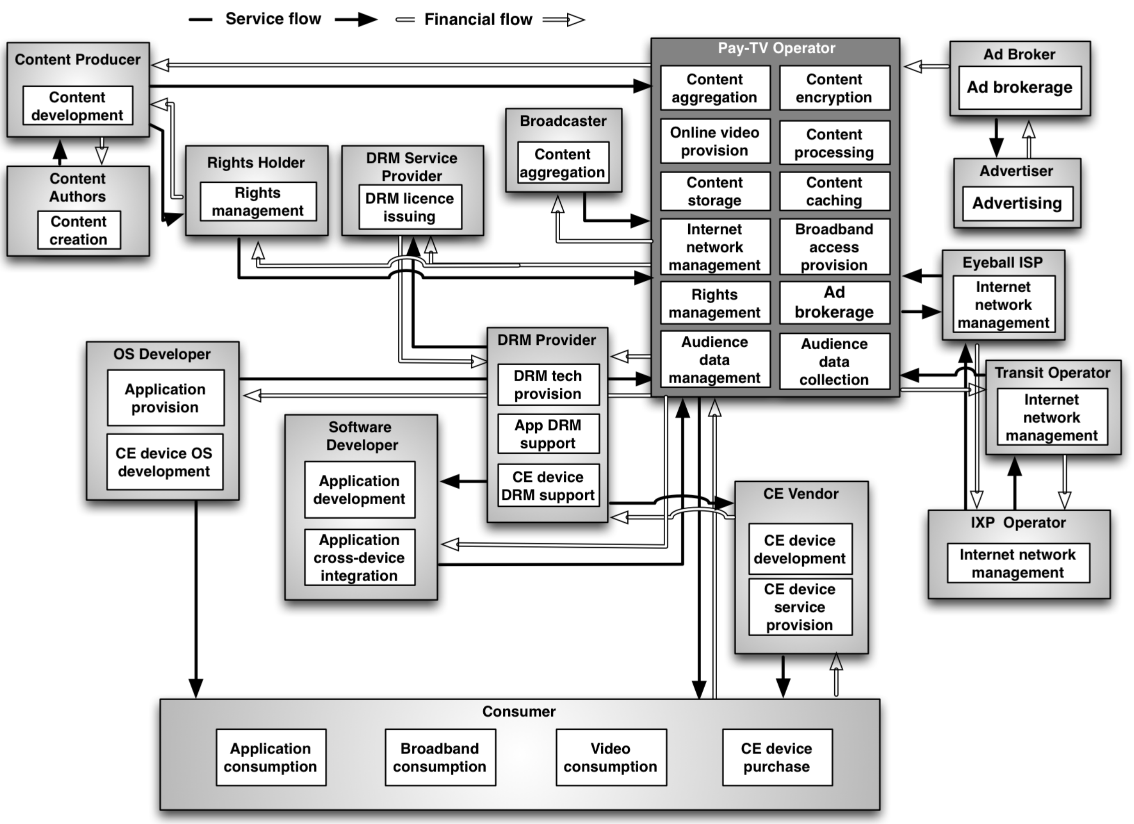


Figure 7.5: Business model configuration characterising My Personal TV scenario.

In this scenario, pay-TV operators control service provision and billing for content and apps through a direct customer relationship. They also control rights management and content aggregation as they hold the power to manage the platform/marketplace for content publication and distribution. Therefore, content providers and rights holders depend on pay-TV operators for marketing content and for audience management data. In addition, pay-TV operators control the revenue sharing model and have bargaining power over content providers and rights holders. The same applies to app developers publishing apps in the pay-TV operators marketplace. Finally, content storage and delivery is entirely controlled by pay-TV operators, holding the power to configure the desired QoS or discriminate traffic. The corresponding business model configuration for this scenario is shown in Figure 7.5.

Table 7.3 summarises the characteristics of the four Future Media Internet scenarios highlighting (1) the lead actors in each scenario, (2) how these actors build the service's value proposition[14], (3) the dominant technological and business characteristics, (4) the main gatekeeper roles, and (5) the potential constraints that may prevent the success of the scenario.

In the Survival of the Fittest scenario, the actors in the best position to secure the aggregation of the most attractive and differentiating content will lead. Therefore, the success of this scenario, which may be centred on any actor, largely depends on the content deals achieved through partnerships and M&As between the lead actors and content producers and rights holders. The latter actors, by controlling the content development and rights management gatekeeper role, will thus have the bargaining position to stipulate the market conditions for pricing, exclusive deals and content release windows. The fragmentation of the most attractive content over multiple services and providers, may however constitute a factor of frustration for consumers.

The Content Supremacy scenario and corresponding business model configuration is centred on content producers and rights holders. These actors control content development and rights management, content aggregation, service provision and billing, and audience management. Therefore, compared to the current business model configuration, in this scenario these actors completely control the service provision and billing gatekeeper role, establishing a direct customer relationship.

[14]The value proposition may be defined as the value that a provider intends to offer to customers or end-users with the product or service, and for which these targeted users are expected to be willing to pay (Ballon, 2007).

Table 7.3: Comparison of the four Future Media Internet scenarios.

	Survival of the Fittest	Content Supremacy	Device Islands	My Personal TV
Lead Actors	• Online Video Aggregators • Content Producers & Rights Holders • CE Vendors • Internet Players • Pay-TV Operators • Broadcasters	• Content Producers & Rights Holders	• CE Vendors • (Internet Players)	• Pay-TV Operators
Value Proposition	Built on securing a differentiating and exclusive content catalogue	Built on the one-stop shop concept with earlier content releases	Built on tight coupling between hardware, software and content	Built on an integrated and personalised experience across linear/non-linear content, fixed/mobile broadband and devices
Dominant Characteristics	• Strict content licencing processes • QoS adaptation and context awareness at device level • Fragmented value networks, pricing and content across geographies • Strong competition • Low interoperability between devices, DRM and content formats	• Strict content licencing processes • QoS adaptation and context awareness at network level • New levels of consumer engagement and content production • Co-operative partnerships amongst Content Producers & Rights Holders • Closed partnerships between Content Producers and ISPs • Anti-competitive practices re exploitation windows	• Soft content licencing processes • QoS adaptation and context awareness at device level • Proprietary standards and lack of interoperability between services • Monopolised and closed ecosystems • Closed partnerships between CE Vendors and Content Producers	• Soft content licencing processes • QoS adaptation and context awareness at network level • Control of network resources • New levels of consumer engagement and personalisation • Closed consumer ecosystem • Open platform/marketplace for content and apps • Content/app discrimination through quality and recommendations
Main Gatekeeper Roles	• Content development and rights management • Content aggregation	• Content development and rights management • Content aggregation • Service provision and billing • Audience management	• Content aggregation • Service cross-device integration • Content storage and delivery • Service provision and billing • Audience management	• Content rights management • Content aggregation • Content storage and delivery • Service provision and billing • Audience management
Constraints	• Users' frustration over multiple relationships with different actors • Partnerships and M&As between actors and Content Producers and Rights Holders	• Partnerships between Content Producers & Rights Holders and ISPs • Coopetition between Content Producers & Rights Holders for content catalogue and market share	• Partnerships and funding agreements between CE Vendors and Content Producers & Rights Holders • Consumers prefer legal services	• Consumers value an integrated, personalised experience with quality of service • Open platform/marketplace for content and apps

They leverage on their control position to build a compelling content catalogue and hold back content from other actors until content is officially released on their own services. The success of this scenario depends to a great extent on the strategic relationships and revenue sharing models set up with ISPs, which control the content storage and delivery gatekeeper role. Through this gatekeeper role and based on the partnerships established, ISPs may choose to differentiate traffic between online video services or charge content producers and rights holders differently for the traffic carried in their networks. The way different content producers and rights holders compete and cooperate in the online video services market can influence the success of some services over others.

In the Device Islands scenario, the leading actor is the CE vendor, controlling most of the gatekeeper roles. With the tight and closed integration between hardware, software and content, all technology and device development activities, as well as content aggregation, storage and caching, would be controlled by CE vendors. The success of this scenario relies on consumer acceptance of legal video services and on the partnerships and funding deals made with content producers and rights holders to guarantee exclusive and compelling content. A final consideration about this scenario relates to the similarities of market strategies between CE vendors and Internet players. As discussed in Section 5.2.4, several Internet Players such as Apple, Google and Amazon lead the market share for CE devices through a diversified offer in personal devices (smartphones and tablets) and home entertainment devices (digital media hubs). However, compared to Internet players, CE vendors such as Sony and Samsung are in an advantageous position as they are strong brands in the market for a number of home entertainment CE devices (TV sets, game consoles, media players) as well as personal devices (smartphones and tablets). This scenario with the same gatekeeper roles and constraints could very well encompass Internet players.

The My Personal TV scenario is centred on the pay-TV provider actor. Pay-TV providers usually offer a number of services in a single package, such as TV, phone, broadband and Internet access. In this scenario, they also offer online video services with seamless integration between linear and non-linear content. Content playlists can be customised by the consumer across devices and environments (fixed and mobile Internet access). By offering rights holders and content producers an open platform to publish content, pay-TV providers gain a foothold in rights management and keep a share of the revenue of content watched through their online video services. This way, pay-TV providers control all gatekeeper roles, except content development and service cross-device integration. They are also in a position to differentiate the quality of video distribution by adjusting the QoS for content from certain providers or depending on the conditions set out in the marketplace, as well as to discriminate how content shows up in search results and user recommendations. The success of this scenario highly depends on the value consumers atribute to a service centred on personalisation, integration and quality of service. Furthermore, the advantages and expected returns of the open marketplace for content need to be compelling and convincing in order for content providers and rights holders to adhere in mass.

Each scenario's dominant characteristics highlight the main control points, which are summarised in Table 7.4. In general, most of the control points will still hold in the future although their specific conditions may change compared to the current status and they will necessarily gravitate around different actors. For instance, licencing agreements and release windows will still be control points, but the terms imposed by rights holders may be different in each scenario. There is however, a shift in control points at consumer level. These control points are not only focused on the customer relationship but also on raising the importance of the online video service for the consumer, by controlling personalisation and quality of experience.

Table 7.4: Changes in control points in Future Media Internet scenarios.

Control Points	Current Status	Future Media Scenarios			
		Survival of the Fittest	Content Supremacy	Device Islands	My Personal TV
Content	• Licencing agreements • Release windows • Content aggregation • Content exposure	• Licencing agreements • Release windows • Financial leverage • Content aggregation	• Licencing agreements • Release windows • Content aggregation	• Content production • Content aggregation	• Content marketplace • Content aggregation
Distribution	• Internet distribution • Traffic management • Content caching	• Internet distribution • Traffic management • Content caching	• Internet distribution • Traffic management • QoS guarantees	• Internet distribution	• Internet distribution • Traffic management • QoS adaptation
Application	• Application development • Application DRM support	• Application development • Application DRM support	• Application DRM support	• Application development • Proprietary standards	• Application development • Application DRM support • Appstore
Device	• Operating system • Application provision on connected devices • Device DRM support	• Operating system • Device DRM support • QoS adaptation and context awareness	• Operating system • Device DRM support	• Operating system • Proprietary standards • QoS adaptation and context awareness	• Operating system • Device DRM support
Consumption	• Source of revenue and information • Service bundling • TV Everywhere access • Simultaneous streams	• Source of revenue • Quality of experience	• Customer relationship – one-stop shop • Audience information	• Source of revenue • Quality of experience	• Service personalisation • Source of revenue • Audience information • Service bundling

As discussed previously, the gatekeeper roles proposed in Section 5.2 are still relevant but the ownership of several gatekeeper roles may change in the future. Table 7.5 offers a perspective of the gatekeeper roles ownership of the Future Media Internet scenarios and the corresponding current business model configuration. As the Survival of the Fittest is the closest scenario to the current status of the market the comparison with the current state has not been included in the table. In this scenario, all types of actors will fight for content rights management, content aggregation and service provision, while the ownership of the remaining gatekeeper roles becomes less relevant. For the remaining scenarios the leading actors, entirely control most of the gatekeeper roles, except for content storage and delivery, service cross-device integration, and audience management. Overall, the Future Media Internet scenarios emphasise that actors that control the resources that influence

Internet distribution and quality of experience will have a bargaining position to stipulate market conditions for online video services. Therefore a smart move for online video service providers may be to become closer to these actors, e.g. through partnerships or acquisitions. Content will still be king, but the differentiation between services will increasingly rely on the whole consumer experience, e.g. tailored to the context of the consumer, personalised, multi-screen, with interactive and immersive content.

Table 7.5: Comparison of ownership of gatekeeper roles between the current state and Future Media Internet scenarios.

Business Model Configurations	**Gatekeeper roles**					
	Content development & rights management	Content aggregation	Content storage and delivery	Service cross-device integration	Service provision/ brokerage & billing	Audience management
FMI scenario **Survival of the Fittest**	• Online Video Aggregators • Content Producers & Rights Holders • CE Vendors • Internet Players • Pay-TV operators • Broadcasters	• Online Video Aggregators • Content Producers & Rights Holders • CE Vendors • Internet Players • Pay-TV operators • Broadcasters	• Cloud Providers • CDNs • ISPs	• Software Developers • DRM providers • OS vendors • Appstores • CE Vendors	• Online Video Aggregators • Content Producers & Rights Holders • CE Vendors • Internet Players • Pay-TV Operators • Broadcasters	• Online Video Aggregators • Content Producers & Rights Holders • CE Vendors • Internet Players • Pay-TV Operators • Broadcasters
Current state **Content Producers and Rights Holders**	• Content Producers • Rights Holders	• Content Producers • Rights Holders	• Cloud Providers • CDNs • ISPs	• Software Developers • DRM providers • OS vendors • Appstores • CE Vendors	• Content Producers • Rights Holders • CE Vendors	• Content Producers • Rights Holders • CE Vendors
FMI scenario **Content Supremacy**	• Content Producers • Rights Holders	• Content Producers • Rights Holders	• ISPs	• DRM providers • OS vendors • Appstores • CE Vendors • Content Producers • Rights Holders	• Content Producers • Rights Holders	• Content Producers • Rights Holders
Current state **CE Vendors and Internet Players**	• Rights Holders • Distributors • CE Vendors • Internet Players • Broadcasters	• CE Vendors • Internet Players	• CE Vendors • Internet Players • CDNs • ISPs	• Software Developers • DRM providers • OS vendors • Appstores • CE Vendors • Internet Players	• CE Vendors • Internet Players	• CE Vendors • Internet Players
FMI scenario **Device Islands**	• Rights Holders • Distributors • Broadcasters	• CE Vendors • Internet Players	• CE Vendors • Internet Players • ISPs	• CE Vendors • OS vendors • Software Developers • Internet Players	• CE Vendors • Internet Players	• CE Vendors • Internet Players
Current state **Pay-TV operators**	• Rights Holders • Distributors • Broadcasters	• Pay-TV operators	• Pay-TV operators	• Software Developers • DRM providers • OS vendors • Appstores • CE Vendors • Pay-TV operators	• Pay-TV operators • CE vendors	• Pay-TV operators • CE vendors
FMI scenario **My Personal TV**	• Rights Holders • Distributors • Broadcasters • Pay-TV operators	• Pay-TV operators	• Pay-TV operators	• Software Developers • DRM providers • OS vendors • CE Vendors • Pay-TV operators	• Pay-TV operators	• Rights Holders • Content Producers • Pay-TV operators

These Future Media Internet scenarios and the corresponding business model configurations previously presented provide the answer to the third research question. The aim of these hypothetical scenarios was not to show which ones are more likely to emerge or succeed, but rather to put in perspective the type of impact the introduction of Future Media Internet could generate on the business dynamics around online video services. By sketching these Future Media Internet scenarios with a focus on different lead actors, it was possible to highlight the main changes and challenges the lead actors would face, as well as how they would impact other actors in the value network.

Therefore these Future Media Internet scenarios can help decision-makers to reflect on emerging opportunities and risks, and how evolving strategies fit in different future environments. The scenarios are also a valuable analytical tool for policy makers to gain new insights and perspectives about the future and a good baseline for initiating discussions about the potential need for policy and regulatory intervention. The following section will introduce these discussions.

7.3 Policy and Regulatory Considerations

This section intends to discuss policy and regulatory changes that could tackle some of the control points previously identified in Section 5.1 and address the imbalances identified in the scenarios. As services on the Internet remain essentially unregulated and audiovisual services normally abide by a regulatory framework, the points raised in this discussion should be read as issues for consideration, and not be presumed as specific needs for effective governmental intervention. These considerations are organised by value stream — Content, Distribution, Application, Device, and Consumption — as is the value network and control points previously presented.

This section also answers the last research question *(RQ4) Which potential future policy and regulatory changes could help balance actors' relationships?*.

Content stream

The policy and regulatory considerations at content level are mainly related with perceived differing licencing processes and market conditions for linear and non-linear video services. Both in the U.S. and in Europe audiovisual regulatory frameworks separate and apply different rules to the two categories of services.

It is however difficult to argue for any of the two sides: should regulatory bodies aim at harmonising rules for both categories of services or should rules for the two categories be different in order to promote the development of online video services?

With regards to licencing processes and release windows, their fragmentation across distribution markets and duration (i.e. certain European countries have legislative provisions fixing the duration of windows) build the case for content piracy. Although release windows have been generally shortened up, the non-simultaneous release of content across markets reinforces consumer frustration and the demand for unauthorised access to content. As most online video services are subject to longer windows, their catalogue is less attractive and it is harder to build up a large customer base. However, policy makers can incentivise rights holders to explore alternative release windows — for example, a reduction of windows' duration for online video services (e.g. for SVOD) or simultaneous release across all distribution markets. With regards to issuing licencing rights, international players experience added burdens in having to licence content for each country they operate in. Normally, each country has its own legislative obligations with regards to territorial licencing. This puts international players in a disadvantageous position compared to national players and weakens competition. Nevertheless, forcing producers and rights holders to issue multi-territorial licences may impose on them more investments which they may not be willing to make, and ultimately resulting in less content being released. Therefore, multi-territorial licencing can be encouraged, but should not be a mandatory requirement.

Regarding market conditions, currently regulatory frameworks in place usually distinguish between linear and non-linear services and impose cultural, societal and financial conditions on the first. Applying the same obligations for linear and non-linear services would imply tougher obligations for the latter. However, rules promoting pluralism, safeguarding linguistic and cultural diversity are equally important in the case of online video services. These would ensure that online video services would also have available national content and a diversified content catalogue. In addition, as mentioned by interviewees, some online video service providers are circumventing their taxes obligations as well as the rules to contribute to financing production. While this distorts market conditions and causes huge discrepancies between players, if stricter rules are imposed they may result in additional financial investments for online video service providers and weaken competition. Regulatory harmonisation between the two types of services may encompass experimenting with new and common models for content funding, or for financial support of cultural obligations (e.g. contributing to digitalise and make available on online video services cultural heritage content). Furthermore, as market expansion is desirable for european players to explore non-EU markets as well as for non-european players to launch new services in Europe, policy and regulatory measures should be studied in order to minimise the distortions of obligations for national players versus non-national players. As much as possible, all players should be subject to the same rules, in order to achieve a level playing field so that all players compete on an equal footing.

With online video services we are seeing other types of actors, e.g. Internet players producing and investing in new content formats. However, content is traditionally produced for TV and cinema, and funding schemes often impose rules on how funded contend should be distributed over the traditional markets. Should content funding policies also consider funding content (exclusively) for online distribution? Policy makers should consider new funding models and content formats, and embrace the online market as another distribution market, as well as it character of having no geographical boundaries.

Finally, as a privileged channel to reach a wide and diverse audience, online video services could be encouraged to distribute cultural heritage content. This incentive could be part of cultural obligations rules, which would include online video services. Other policy/regulatory measures could try to address the uncertain state of cultural works with unclear rights holders and orphan works. These could be considered under the scope of cultural heritage and be released for digital distribution under certain conditions.

It is important that policy makers and regulation promote common and flexible measures that guarantee consumer protection and access to content, while encouraging investment, fair market competition, and development of new content and both linear and non-linear video services.

Distribution Stream

There are several issues related with Internet distribution. Tensions between content and service providers and ISPs have occurred in the recent years, with the latter claiming they cannot support the costs of carrying the increasing traffic of video content. ISPs, from their gatekeeper role, demand additional revenue streams, often a revenue share or fee from content and service providers, to cope with infrastructure investments. Research around Future Internet and Future Media suggests that infrastructure investments would be needed in order to incorporate new network and other functionalities. As suggested in the scenarios, as a response to FI investments, ISPs and pay-TV operators could engage in traffic or price discrimination. Such practices could threaten the net neutrality principles. Engaging in traffic discrimination seems relatively straightforward in FI as QoS management techniques would be supported in the core and edge of the network. ISPs and pay-TV providers could thus differentiate online video services, i.e. their traffic speeds and consequently the delivered quality of experience to the consumer, based on the revenue share agreed with service providers or the amount charged per traffic transmitted. Alternatively, ISPs and pay-TV providers could set up different prices for the traffic transmitted over their networks, depending on the size of the provider. A large provider, although transmitting considerably more traffic than a small provider, will have the bargaining position to negotiate and secure lower prices than a small provider. This would significantly raise the entry barriers for small providers and hinder competition. Potential regulatory measures to address these issues could encompass defining specific transparency obligations to ensure online video services providers would have access to similar conditions. However, current competition law could very well suffice to address potential issues related with market distortion.

Similar situations about the need to finance networks' expansion and upgrades can be generally claimed by fixed and mobile operators in order to develop fixed and mobile broadband. In Europe, in the scope of the Digital Agenda strategy, a specific investment plan has been setup to ensure that Member States are covered nationwide with at least 30 Mbps broadband by 2020. In the U.S., the National Broadband Plan setup in 2010 also aims at improving Internet access at affordable prices. In other countries, policy makers may need to consider and study the need for public funding to support broadband development, but private investments should also be incentivised. Moreover, for mobile broadband development, there may be specific needs to allocate (or reallocate) additional spectrum to increase capacity. The arrival of 5G may may provide the additional capacity needed to cope with the upward trend of consuming video content on mobile devices, but telecom operators would also need assurance of spectrum allocation to encourage 5G investments and deployments.

The concerns expressed in the interviews over the relationships between ISPs and CDNs may not materialise in the future. The importance of CDNs in the delivery of content to the consumer could be significantly lower in Future Media Internet and hence not be perceived as a control point. Nonetheless, as previously mentioned, the agreements between ISPs and CDNs resemble to some extent peering agreements between ISPs. The model of transit and peering agreements for IP interconnection between ISPs is market-based and unregulated. It is generally very robust and has not needed regulatory intervention so far. As such, the relationship between

ISPs and CDNs may not need regulatory intervention, but policy makers should be aware that cases of differentiated and discriminatory treatment may exist. In such cases, transparency and non-discriminatory interconnection obligations may be called to resolve potential disputes between stakeholders and deal with potential abuses of power from ISPs.

Application Stream

At application level, interviewees emphasised the considerable costs of application development, due to multiple SDKs and the fast pace of new operating systems' releases. Although innovation at device level is desirable, this also raises entry barriers for small online video service providers which do not have large availability of financial and technical resources. Open standards, interoperability between technologies, and backward compatibility between versions should be promoted so that a balanced compromise between innovation processes and a level playing field for small and big players is achieved.

Also worth highlighting that online video service providers are the gatekeepers, at application level, of consumer data and content search capabilities. Consumer data, and in particular, data about individual consumption and market consumption trends, are becoming increasingly interesting for service providers and advertising firms. As such, regulatory measures should be encouraged to ensure consumer protection, and in particular privacy and protection of personal data, so that a particular consumer cannot be traced or identified outside the scope of the online video service.

With regards to search and recommendation capabilities, applications, through their algorithms, may manipulate the content the consumer visualises and the relevance content gets in search and recommendation results. As suggested in the scenarios, service providers hold the power to discriminate access to content originating from different content distributors. A small content distributor/rights holder may see its content lose relevance in search results, while a big player, which embarked in exclusive contents deals with the online video service provider, may get its content promoted to rank higher in search results. Measures may be needed to ensure equal access and non-discriminatory treatment for smaller players so that their content can be accessed and found by consumers. Correspondingly, consumers should be able to find and access all content available in the services. Therefore, transparency and accountability of application functionalities and algorithms should be advocated.

Device Stream

As mentioned in the expert interviews, application providers and online video service providers also struggle to deploy applications and their services to a wide range of operating systems and devices due to their non-harmonised support of streaming and DRM technologies. Developing interoperable technologies for multiple operating systems and screens is essential for services and competition to thrive and to ensure consumers get the best user experience when switching between devices.

Therefore, to ensure fair competition between online video services, to foster the development of new services and lower entry barriers and time-to-market, policy makers should promote a technology-neutral approach as well as effective standardisation, so that online video services and video content are not treated differently based on the devices consumers are using. Practices of OS and CE vendors regarding the lack of support of technologies developed or supported by competing vendors and placement/pre-installation of their own online video services in CE operating systems should be carefully analysed under the terms of competition law to prevent market distortion and protect consumers. Internet players such as Apple or Google not only control the device and OS, but also the approval process of apps on the appstore, thus limiting the technologies supported in these devices and the competing third-party apps/services. These practices limit user experience and consumers' choice.

Consumption Stream

From the consumer perspective, non-discriminatory access to services should be ensured, either from the network perspective or from the device level. Independently of the device type the user is using or the broadband/network provider the user is attached to, online video services should be available and working the same way for all users. That means the same content should be available for the users, avoiding discriminatory practices such as content filtering or promotion of certain content over other. Fair competition between services and providers should be promoted, while ensuring consumer protection.

Moreover, transparency and portability of content between services should be promoted. If a film is acquired through an EST-based service, the consumer should be allowed to transfer and play that film in a similar and competing service. Otherwise, the consumer is locked within a service.

Finally, net neutrality principles from the user perspective are also a sensitive issue. It is not obvious if regulation should prevent online video service providers from discriminating access to content depending on the QoS/capacity rate of the network service the user is using, in order to increase the consumer's quality of experience. For instance, in this scenario, online video service providers could filter out rich media content for consumers with low QoS network conditions, so that those consumers do not experience low service performance and constant viewing interruptions. However, it may be the case that a consumer prefers to experience a low performant playback and still have access to the content she is interested in, than not having access at all to that content. Therefore, ensuring transparency in content access is required in online video services' practices in order to allow consumers to make informed choices about the services available on the market.

7.4 Conclusion

This final chapter completed the analysis through the remaining steps of the adopted methodology and provided the answers to the remaining research questions.

The first section presented triggers — plausible factors, events and issues — that may motivate dynamic changes to the control points and hence to business models. Through an exploratory analysis of factors raised in expert interviews, market trends, and issues under discussion at regulatory and academic level, a number of technological, business, regulatory and social triggers were described. These triggers answer *(RQ2) Which factors may affect the dynamics of control and power positions between actors?*

Technological triggers are mainly related with improvements in user experience, at application, device and network levels. New functionalities, convergence and wide adoption of standards will all contribute to deliver an intuitive, user-friendly personalised experience across devices taking into consideration users' context, searchability needs and mobility.

At business level, triggers are mainly related with changes in content licencing processes and in content funding and how these factors could impact content production and competition between legal and illegal services. The market should also be prepared to deliver new tools and metrics for audience measurement and management across multiple devices and social network platforms benefiting advertisers and content creators/producers in revenue generation and content production.

At social level, contrasting but not exclusive consumption modes will develop and persist. Individualised and personalised experiences would be attractive to certain types of consumers, offering more power and control over the content one consumes, but with added service usage complexity. Other consumers would still value physical ownership, TV watching and cinema-going, for the simplicity, reliability and social interaction these consumption modes carry.

Regulatory triggers are also suggested, although it is clear that the current regulatory setting favours self regulating markets for sectors which are still taking off. However, a number of regulatory triggers could affect control points and actor relationships, such as the ones related with content licencing processes, the territoriality and country of origin principles, taxation and cultural obligations, preferential treatment between players with bigger financial and market capacities, and traffic prioritisation based on content type or content provider.

Using as a basis an empirical analysis of the impact of these triggers on the future development of online video services and their importance to business actors, Section 7.2 presented the two premises to construct four scenarios for the future of online video services. Pondering on the uncertainties about content licencing models and the customisation of QoS for delivering content services, the following scenarios were derived: (1) Survival of the Fittest, (2) Content Supremacy, (3) Device Islands, and (4) My Personal TV. For each scenario, the dynamics of the market, services' characteristics, and changes to the business model configurations and gatekeeper roles were discussed.

In the Survival of the Fittest scenario, the actors in the best position to secure the aggregation of the most attractive and differentiating content will lead. Therefore, the success of this scenario, which may be centred on any actor, largely depends on the content deals achieved through partnerships and M&As between the lead actors and content producers and rights holders. The latter actors, by controlling the content development and rights management gatekeeper role, will thus have the bargaining position to stipulate the market conditions for pricing, exclusive deals and content release windows. The fragmentation of the most attractive content over multiple services and providers, may however constitute a factor of frustration for consumers.

The Content Supremacy scenario is centred on content producers and rights holders. These actors control content development and rights management, content aggregation, and compared to the current business model configuration, they also control service provision and billing allowing them to establishing a direct customer relationship. In this scenario, these actors leverage on their control position on content rights management and aggregation to build a compelling content catalogue and hold back content from other actors until content is released on their own services. The success of this scenario largely depends on the strategic relationships and revenue sharing models set up with ISPs, which control the content storage and delivery gatekeeper role. Through this gatekeeper role and based on the partnerships established, ISPs may choose to differentiate traffic between online video services or charge content producers and rights holders differently for the traffic carried in their networks. The way different content producers and rights holders compete and cooperate in the online video services market can influence the success of some services over others.

The Device Islands scenario is centred on the CE vendor. With the tight and closed integration between hardware, software and content, this actor controls most of the gatekeeper roles from technology and device development activities, to content aggregation, storage, caching, and billing. The success of this scenario relies on consumer acceptance of legal video services and on the partnerships and funding deals made with content producers and rights holders to guarantee exclusive and compelling content. This scenario with the same gatekeeper roles and constraints could very well encompass Internet players, as both types of actors show similarities in the strategies they are currently pursuing.

In the My Personal TV scenario, the pay-TV provider is the leading actor. In this scenario, pay-TV providers also offer online video services with seamless integration between linear and non-linear content. Content playlists can be customised by the consumer across devices and environments. By offering rights holders and content producers an open platform to publish content, pay-TV providers gain a foothold in rights management and gather a share of the revenue of content watched through their online video services. Thus, compared to the current business model configuration, pay-TV providers control an additional gatekeeper role — rights management. They are also in a position to differentiate the quality of video distribution by adjusting the QoS for content from certain providers or depending on the conditions set out in the marketplace, as well as to discriminate how content shows up in search results and user recommendations. The success of this scenario highly depends on the value consumers atribute to a service centred on personalisation, integration and quality of service. Furthermore, the advantages and expected returns of the open marketplace for content need to be compelling and convincing in order for content providers and rights holders to adhere in mass.

These scenarios and the corresponding business model configurations previously presented provide the answer to the third research question *(RQ3) Which new business model configurations could emerge?*. In general, most of the control points will still hold in the future although their specific conditions may change compared to the current status and they will necessarily gravitate around different actors. Therefore, the ownership of several gatekeeper roles may change in the future scenarios. In the majority of the Future Media Internet scenarios, the leading actors entirely control most of the gatekeeper roles, except for content storage and delivery, service cross-device integration, and audience management. Overall, the Future Media Internet scenarios emphasise the role of the actors who control the resources to optimise Internet distribution and quality of experience. These will have a bargaining position to stipulate market conditions for online video services. For this reason, online video service providers may urge to become closer to these actors, e.g. through partnerships or acquisitions. Content will still be king, but the differentiation between services will increasingly rely on the whole consumer experience, i.e. tailored to the context of the consumer, personalised, multi-screen, with interactive and immersive content.

Finally, the last section addressed the last research question with regards to policy and regulatory considerations that could take forward some of the control points identified in expert interviews and the imbalances described in the scenarios. These considerations were organised by value stream — Content, Distribution, Application, Device, and Consumption streams. In general, policy and regulatory interventions, if any, should aim at promoting innovation, development, transparency, accountability and fair competition between online video services themselves and with other actors in the value network. It is equally important to encourage measures that guarantee consumer protection, privacy and protection of personal data, as well as non-discriminatory access to content and services through interoperable technologies and services.

Chapter 8

Conclusions

This final chapter concludes and overviews the main findings of this study. The research objectives of this thesis were twofold. The first concerned the characterisation of the current value network of online video services regarding its business roles, actors and stakeholders and the identification of power positions among actors. These power positions were expressed by way of control points and the identification of gatekeeper roles, based on in-depth expert interviews. The second objective positioned online video services in the realms of Future Internet and Future Media and aimed to uncover potential evolutions of the value network and the dynamics of power and control relationships.

Four research questions have been formulated to address these objectives. Taking the perspective of recent Future Internet and Future Media research and standardisation developments, the first research question studied was:

(RQ1) How are the technical requirements of the media business stakeholders being accommodated by FI design and standardisation activities?

Assuming a scenario wherein technological changes aiming at improving media distribution and performance move from research to the market, the following research questions were addressed:

(RQ2) Which factors may affect the dynamics of control and power positions between actors?

(RQ3) Which new business model configurations could emerge?

(RQ4) Which potential future policy and regulatory changes could help balance actors' relationships?

This research was framed within a multidisciplinary approach combining concepts from innovation theory, political economy and strategic management literature. The rationale behind this approach was grounded on the importance of considering the interrelationships between technology, institutions, markets and policies and the issues that emerge from those relationships, which potentially contribute to shaping technology introduction and diffusion. By combining these three theories, the adopted methodology put forward by Trossen and Fine (2005), grounded in architectural innovation, and developed within the Value Chain Dynamics Working Group (VCDWG), part of the MIT Communications Futures Program (CFP), matched the aims of this study in what concerned deriving insights about the articulations of power and control and how these influence competition and strategic behaviours, as well as in revealing policy and strategic dynamics behind technological change and market reorganisation. However, the methodology has been enriched to operationalise the identification of value networks instead of value chains, group control points around gatekeeper roles, and construct scenarios based on uncertainty factors uncovered via triggers.

In the next section, an overview of the previous seven chapters is provided. In the following section, the main contributions of this thesis to theory and methodological frameworks are identified. The third section recollects the main empirical contributions and reiterates the main findings associated with each research question. Finally, this chapter concludes with the identification of the main limitations of this study and of potential avenues for further research.

8.1 Overview of the Thesis

Chapter 1 introduced the context and motivation for this thesis and its research questions. This study was also situated in relation to other studies.

Chapter 2 provided the theoretical background deriving from innovation theory, political economy and strategic management. The concepts and assumptions of the three traditions were presented highlighting the interconnection between technology design and innovation, and the interdependence between power and technology, markets and institutions. It was argued for a prospective, exploratory and multidisciplinary approach which could accommodate an empirical study of the uncertainty behind technological development based on the interplay between technology design, policy, institutions and markets.

Chapter 3 presented the methodology adopted for this research, which is based on a set of tools developed by the Value Chain Dynamics Working Group (VCDWG), part of the MIT Communications Futures Program (CFP). This methodology provides the needed operationalisation to study the impact of control points on architectural innovation. As the VCDWG methodology has several shortcomings, five new steps were proposed relying on a qualitative approach based on desk research, document analysis and expert interviews. The proposed methodology consisted of (1) the analysis of online video services towards the definition of a taxonomy of the current state of online video services and the identification of a generic value network, (2) the identification of positions of sustainable power, (3) the enumeration of varying current business model configurations through gatekeeper roles, (4) the identification of technological, regulatory, social and business triggers that may impact the dynamics of power and control in the future, and (5) capture this impact by postulating future scenarios for online video. In addition, this chapter critically reviewed existing ontologies for value network analysis, business modelling analysis and scenario construction.

Chapter 4 overviewed the current state of online video services. Services available in the U.S. and European markets, related and unrelated with the interviewees that participated in this study, were chosen to put in evidence the broad range of service characteristics, trends and strategies employed by the main actors involved in online video services provision, and to highlight distinctive service features/characteristics towards the construction of a taxonomy of online video services. Furthermore, a brief overview of the typical digital video workflow was provided, together with the characterisation of the dominant technologies for encoding, streaming and enforcing commercial licencing rights through digital rights management (DRM). The stress on these technologies was justified by issues raised by the interviewees: choosing and adopting these technologies represent a high cost for online video service providers both in licencing and in app development, as the compatibility matrix between end-user devices and technology (i.e. which device supports each technology) is quite sparse. Finally, a generic value network representing the current market state of online video services was proposed, resulting from an iterative process of refinements made with the feedback obtained from expert interviews. In this regard, business roles, business actors and revenue models were also examined.

Chapter 5 analysed the major dynamics occurring in online video services through the lenses of the control point and the gatekeeper role concepts. The control points identified by means of in-depth interviews were mostly raised as bottlenecks, as gatekeeper points, affecting the business and development of online video, and in many cases deeply intertwined with the film, broadcasting, telecommunications and Internet sectors. Most of the control points identified were of technical or business nature. Only a few regulatory control points were identified, suggesting that online video services are still at an early stage of development. As organisations are still reconfiguring and adapting, the market is still very much self-regulated and regulation plays little influence in the current market dynamics. Through six gatekeeper roles, a number of business model configurations were presented centred on different actors holding service provision — online video aggregators, content producers and rights holders, CE vendors, Internet players, pay-TV operators, and broadcasters. It was demonstrated that the gatekeeper roles of content development and content delivery are still controlled by the traditional gatekeepers of the media and telecommunications industries, respectively. There are only a few examples of stakeholders which decided to take hold of these functions and moved into those domains, employing strategies of merger and acquisitions or scaling up their businesses. The other gatekeeping roles seem easier to take hold of, since several actors have been able to introduce those gatekeeping functions in their businesses. The business model configurations derived in this chapter showed that certain actors are better positioned than others to succeed since, on the one hand, they are in control of crucial assets for service provision, and on the other hand, they control the customer relationship, either through previously established business relationships or through tight coupling with other services and hardware. Examples also shown that service provision does not necessarily mean customer ownership. Devices are playing a prominent role in the intermediation with the consumer and, in particular conditions, are allowing CE vendors to control the billing relationship and consequently the revenue sharing with online video service providers.

Chapter 6 offered an overview of Future Internet's requirements and design goals as well as an account of the approaches and research programmes being considered for the evolution of the current Internet architecture. Standardisation activities undertaken by ISO/IEC and ITU-T related with Future Internet and Future Media were described and analysed. Despite having work independently, both standardisation groups' proposals overlap to some extent, specifically in what concerns Future

Network design goals related with media services' challenges and bottlenecks. With regards to Future Media, ISO/IEC argues for a service centric networking approach, while ITU-T advocates for a data centric networking solution. Both approaches aim to deliver seamless mobility, caching, trustworthiness, security, support for different levels of QoS/QoE and heterogenous environments. The ultimate goal in both cases is to provide a suitable delivery of content, overcoming congestions and delays, to a wide range of devices in different user and network contexts. The European research context related to Future Media Internet was also overviewed, seen the great number of initiatives and body of work developed within FP6 and FP7 research programs.

Chapter 7 completed the analysis of this research by addressing the last two steps of the methodology. This chapter addressed the future of online video services by identifying a number of technical, regulatory, business and social factors which may disrupt the current state of the business and hence impact the dynamics of current control points. These factors, i.e. triggers, were the result of an exploratory analysis of factors raised in expert interviews, market trends, and issues under discussion at regulatory and academic level. Using as a basis an empirical analysis of the impact of these triggers on the future development of online video services and their importance to business actors, two uncertainties were derived to construct four Future Media Internet scenarios reflecting the future of online video services. Based on the dichotomies between content licencing models and the customisation of QoS for delivering content services the following four Future Media Internet scenarios were presented: (1) Survival of the Fittest, (2) Content Supremacy, (3) Device Islands, and (4) My Personal TV. These scenarios focused on different lead actors and highlighted the main changes and challenges these would undergo. In addition, emphasis was given to the rearrangements of relationships between the actors through potential transitions in business model configurations and gatekeeper roles. In relation to the control points, triggers, and scenarios, a number of policy and regulatory considerations were also put forward. These considerations mainly revolve around promoting innovation, development, transparency, accountability and fair competition between online video services themselves and with other actors in the value network, and in encouraging measures to protect the consumer, its privacy and personal data, and a non-discriminatory access to content and services through interoperable technologies and services.

8.2 Theoretical and Methodological Findings

At theoretical and methodological level, the main contribution of this thesis was to frame the constructs of power and control through the concept of control point. This study showed that this concept relates to a number of notions around power in innovation theory, political economy of communications, and strategic management, and allowed for an empirical and critical study of the articulations of power and control in the interrelationships between actors and their impact on technology, markets and policy.

Related to the theoretical and methodological state-of-the-art presented in Chapters 2 and 3, this research has contributed to (1) enrich the studies of innovation theory, political economy of communications and strategic management; and (2) to demonstrate how to operationalise researching the underlying cause and effect of bottlenecks in the entanglement between technical and business innovation.

Through a multidisciplinary research framework combining the three aforementioned traditions, a prospective and exploratory study has been conducted about the impact of technical design choices on the future development of online video. This thesis showed the way to identify and examine different alternatives of technical and business dynamics in an uncertain future under the scope of these traditions. It also gave the first steps in identifying the implications of these dynamics for policy and regulation.

By focusing the analysis on architectural innovation, this study has also contributed to the examination of technological and business systems where incremental innovation is taking place with disruptive consequences for the market, and even the sector, dynamics. By testing and extending the tools proposed by Trossen and Fine (2005), this thesis succeed in operationalising and evaluating the impact of control points on innovation and in devising alternatives routes for an uncertain future where control will prevail. With relation to the original methodology, this study proved the need to distance from monolithic and integrated value chains and instead adopt the view of the market as a network in order to study the dynamics of innovation. By combining a market analysis with expert interviews, it has been possible to put in perspective the entanglement between business and market innovation, gain a deep understanding of the underlying technological systems, reveal tendencies in the interplay between stakeholders, through the conceptualisation of control points.

It was also introduced to the original methodology an extended approach to evaluate control points and to group them around gatekeeper roles. Rather than evaluating control points as centralised or distributed points in the architecture, in this study their evaluation was linked to the business model construct. In specific, the introduction of the business model concept allowed to bring in its dimensions of control incorporated in the value network and in the functional architecture. The gatekeeper roles, as replacement for control points constellations, provided a clear view of the activities that constitute critical bottlenecks and allowed for the identification of the actors that control them in each business model configuration. Finally, by incorporating social, technological, business and regulatory triggers, this thesis has contributed to a critical exploration of alternative futures based on power and control relations.

8.3 Empirical Findings

The research pursued in this study was exploratory in nature and its empirical findings can be divided in two types of results. The first, based on empirical data, derived mainly from expert interviews and desk research, and presented in Chapters 4, 5 and 6. The second, which are more speculative in nature, are based on the identification of triggers influencing the evolution of online video services to help deriving scenarios and future business model configurations (Chapter 7).

One differentiating element of this study compared to previous studies (see Section 1.3) resides in the definition of online video services providing professional video content over the Internet, going beyond the over-the-top video term, and encompassing a broad perspective of the market and its actors. Therefore, a taxonomy (Table 4.3) was proposed categorising three types of services — VOD, live and catch-up linear TV, and TV Everywhere — and identifying the main actors coming from the media, ICT and telecommunications sectors providing these services — broadcasters, pay-TV operators, content producers and distributors, rights holders, consumer electronics vendors, Internet players, and online video aggregators. The diversity of online video services reflects not only new services launched by online video aggregators, but also traditional stakeholders' reaction to the market penetration of new services. The latter stakeholders are trying to reinvent their market position, exploring new avenues to monetise resources, reach scale, establish a direct customer relationship, and in some cases, launching 'lighter' and cheaper versions of existing services, in order to retain their customer base. The three types of services rely significantly on the same professional content and compete for the same type of audience, with different revenue models but with little price and feature differentiation.

Through this broad lens, this study contributed to the identification and understanding of online video services value network (Figure 4.12) and the underlying business roles (Table 4.2), by adding further granularity to existing partial views of different services' value chains, and by identifying the diverse actors in the content, distribution, application, and device provision streams. This value network has been validated in expert interviews and served as the basis for the identification of business model configurations.

Based on these interviews it has also been demonstrated that many actors not only contribute to the creation of value, but also to establish positions of control which originate bottlenecks affecting service provision and the development of online video services. This thesis successfully showed evidence that control points in current online video services gravitate around a few actors, which hold critical resources, make efforts to exert control over others or presumably hold more power in influencing or limiting other actors' activities. These control points (Table 5.1) are mainly of technical or business nature. In general, on the one hand, the business control points identified give actors the power to establish the "business rules", establish a direct relationship with consumers, create scarcity effects, influence competition between online video service providers, create entry barriers for small players, and monetise audience information. On the other hand, technical control points generate additional costs associated with technology implementation, deployment and R&D, create entry barriers for small online video service providers with little technological expertise, and originate walled gardens through which applications and content can be filtered and customer billing can be controlled. Less emphasis given by interviewees to regulatory control points, suggests regulation currently plays little influence in the market dynamics.

These points of power have been uncovered by focusing on gatekeeping functions allowing for the identification and interpretation of business model configurations centred on the main providers (Table 5.2) previously identified. This allowed to analyse and compare the strategies and business dynamics employed by different actors and competitors such as online video aggregators (e.g. Netflix), content producers and rights holders (e.g. Hulu), CE vendors (e.g. Sony), Internet players (e.g. Apple), pay-TV operators (e.g. Sky), and broadcasters (e.g. BBC). It was demonstrated how all these actors aspire to control all the gatekeeper functions, although some functions seem easier to control than others, such as content development and rights management. Based on these business model configurations, it was demonstrated that several actors are shifting their activities to other value streams (Figure 5.8), while incorporating new gatekeeping roles by employing, e.g. strategies of merger and acquisitions, partnerships, verticalisation. In this quest for leadership, several players are assessing different business models with some online video services cannibalising each other within their services' offer.

Finally, the last findings derived from empirical data relate with the first research question on how the technical requirements of the media sector are being accommodated by FI design and standardisation activities. This study has concluded that the requirements of the media sector are not being entirely accommodated in Future Internet and Future Media Internet perspectives. It was illustrated that contributors to the standardisation activities and research initiatives mainly come from academia and the telecom world, leading to similar requirements and design goals amongst the different initiatives. It was also argued that real perspectives from the media sector do not appear to have been considered, since the Future Media requirements articulated in these initiatives are focused on the network and IP level and did not go further than technical requirements, unlike envisioned in the seminal definitions of Future Network, i.e. also including economic incentives, service universalisation and service diversity. Lastly, none of the interviewed experts from the media sector were acquainted with the concept of Future Media Internet or Future Internet.

The following results, are still based on the previous empirical data and expert interviews, although they are more speculative and prospective in their essence. They assume a context wherein technological changes postulated by Future Media Internet design requirements stemming from standardisation and research activities (Table 7.1) move from research to the market.

The findings related with the second research question have revealed a number of technological, business, social, and regulatory factors or triggers, which may affect the dynamics of power and control over time and impact different actors and business models. New technical functionalities mostly derived from Future Media Internet requirements, convergence and wide adoption of standards will all contribute to deliver an intuitive, user-friendly personalised experience across devices taking into consideration users' context, searchability needs and mobility. At business level, triggers are mainly related with changes in content licencing processes and in content funding and how these factors will impact content production and competition between legal and illegal services. New tools and metrics for audience measurement and management across multiple devices and social network platforms would emerge benefiting advertisers and content creators/producers in revenue generation and content production. At social level, contrasting but not exclusive consumption modes will develop and persist. Individualised and personalised experiences would be attractive to certain types of consumers, offering more power and control over the content one consumes, but with added service usage complexity. Other consumers would still value physical ownership, TV watching and cinema-going, for the simplicity, reliability and social interaction these consumption modes carry. Regulatory triggers would affect control points and actor relationships, such as the ones related with content licencing processes, the territoriality and country of origin principles, taxation and cultural obligations, preferential treatment between players with bigger financial and market capacities, and traffic prioritisation based on content type or content provider.

In this future context and related with the third research question about future business model configurations, this thesis contributed to identify four Future Media Internet scenarios incorporating two uncertainties related with content licencing models and the customisation of QoS for delivering content services: (1) Survival of the Fittest, (2) Content Supremacy, (3) Device Islands, and (4) My Personal TV. The aim of these hypothetical scenarios was not to show which ones are more likely to emerge or succeed, but rather to put in perspective the type of impact the introduction of Future Media Internet could generate on the business dynamics around online video services. By sketching these scenarios with a focus on different lead actors, it was possible to highlight the main changes and challenges the lead actors would face, as well as how they would impact other actors in the value network. It was shown that most of the control points will still hold in the future (Table 7.4) although their specific conditions may change compared to the current status and they will necessarily gravitate around different actors. Therefore, the same gatekeeper roles will still be valid but their ownership will shift to different actors in the Future Media Internet scenarios (Table 7.5). In the majority of the scenarios, the leading actors entirely control most of the gatekeeper roles, except for content storage and delivery, service cross-device integration, and audience management. The scenarios underlined that actors controlling the resources influencing Internet distribution and quality of experience will have a bargaining position to stipulate market conditions for online video services. Therefore online video service providers may choose to become closer to these actors, e.g. through partnerships or acquisitions. Content would still be king, but the differentiation between services will increasingly rely on the whole consumer experience, e.g. tailored to the context of the consumer, personalised, multi-screen, with interactive and immersive content.

Finally, and in response to the fourth research question, general considerations regarding policy and regulatory measures were uncovered. The identified measures could address some of the control points identified in expert interviews and the imbalances described in the scenarios. These considerations were organised by value stream — Content, Distribution, Application, Device, and Consumption streams. In general, policy and regulatory interventions, if any, should aim at promoting innovation, development, transparency, accountability and fair competition between online video services themselves and with other actors in the value network. It is equally advisable to encourage measures that guarantee consumer protection, privacy and protection of personal data, as well as non-discriminatory access to content and services through interoperable technologies and services.

8.4 Research Limitations and Future Research

The contribution of this study to the understanding of the current ecosystem around online video services and potential evolutions in case of Future Internet deployments has been described in the previous section. There are however a number of aspects which have been only lightly touched or have not been covered with great extent.

First of all, supporting services such as (client-side) analytics or advertising, which contribute to content and service's monetisation, have been considered in a simplified way. It is clear that online video services and the media sector in general also depend on revenue generated from advertising. Effectively the media sector is a two-sided business and future business models for online video services will certainly be influenced by many other factors, besides technical developments of the Internet, but this study has chosen to focus primarily on the activities concerned with delivering content and video services to the consumer through the Internet. Nevertheless, the business roles of audience data collection, audience data management, advertising and ad brokerage have been considered in the value network in order to highlight these business activities have not been overlooked. Although it would be interesting to consider the challenges and revenue opportunities stemming from the recent developments in big data analytics, emergent audience metrics, social media, native and programmatic advertising, in the context of online video services, they certainly constitute enough material for a study on its own.

Furthermore, the impacts of piracy, of emergent unauthorised file-sharing services such as Popcorn-time, and illegal content being constantly released on YouTube, have not been meticulously considered from a business nor policy perspective. The focus of this study has been on commercial legal services, therefore these issues have been substantially neglected. But that is not to say they are not relevant for the future of online video services. On the contrary, as the works of Strangelove (2015) and Idland et al. (2015) prove, illegal services are reshaping the way television content is being distributed and consumed, and are challenging the value propositions and competitiveness of online video services such as Netflix. To explore such impacts would constitute a valuable extension to this thesis.

Certain concepts of the theoretical framework have not been sufficiently explored. For example, the concept of technological trajectory which expresses the notion of a directionality in technical change and translates the idea that, in competitive environments, technology frequently develops and evolves in path dependent ways, could be used to investigate in the context of online video services if first-mover advantage was translated in added market power. In literature, it is generally acknowledged that first movers benefit from additional bargaining power in establishing relationships with suppliers of crucial resources, in laying the foundations of the revenue and pricing models, as well as in influencing how technology and standards further develop. The concept of technological trajectory could thus allow for further explorations of specific online video services and uncover the reasons behind the emergence of particular control points.

An additional extension to this study would be to incorporate platform theory in the theoretical framework in order to delve deeper into the market dynamics and regulatory challenges related to multi-sided platforms. Most of the online video services presented throughout this thesis constitute multi-sided platforms (Hagiu, 2014) as they connect content producers, consumers and advertisers. As mentioned in this study, Smart TVs and digital media players are being built on an ecosystem that also brings into scene app developers. Adding platform theory to this study would allow to explore the relationship between innovation and gatekeeper platforms, as well as how platforms leverage market power through network effects and pricing strategies.

Further analysis of multi-sided platforms would also inform additional work on policy and regulation. Such considerations could be further developed by assessing the impact of platforms on policy and regulation, and vice versa. The online video services discussed in this thesis show that there are a number of platforms operating next to each other as well as competing in the same value network, which are treated differently from a regulatory perspective. This means that policy makers should be aware that in the presence of multi-sided platforms, a self-regulated market where innovation is still maturing may endanger competition, but at the same, may prove to be hard to regulate.

Finally, the findings of this thesis are exploratory and would benefit from further validation and refinements through additional expert interviews. In particular, the prospective analysis could be enriched with feedback from experts. Moreover, since the current state of online video services is slightly more focused on U.S.-based services and context, as there is more public information widely available, this study could be extended with additional expert interviews. However, as services evolve and get adopted in Europe, more information is expected to be available about these services. This could be incorporated and contribute to update and compare the power relations between actors in the US and European markets. A comparative study of US and European regulation covering online video services would also comprise a valuable extension to this thesis.

Appendix A

Interview Protocol

The following interview protocol was used as a reference for the semi-structured interviews with open questions. Depending on the interviewee's expertise and the information received from earlier interviews, the protocol was adapted to better fulfil the goals of the study.

Each interview would focus on collecting information about the following topics:

- What is your current position in your organisation?
- What are your firm's main services?
- What is/are your firm's role(s) in this value network?
- Do you find this value network representative of the current market state?
- Is any relevant business role missing?
- From your point of view, which are the main control points in the provision of your firm's service(s)?
- Which actor(s) do you see as creating bottlenecks in the provision of your firm's service(s)?
- Which actor(s) possess ownership of critical resources?
- Do you think those control positions might change in the future? How and why?
- Considering that an evolution towards Future Media Internet will take place in the future:
  - Do you think your firm's role(s) will change?

- Do you think other actors' roles will change?
- Will any actor be in a better position to control critical resources?

Appendix B

Trigger Importance to Business Actors

Table B.1: Importance of the regulatory, technological, business and social triggers to the various actors.

	Importance to business actors
Regulatory triggers	
1.Erosion of mobile data caps	ISPs; Mobile operators; CDNs; Consumers
2.Quotas for European content	Content Producers; Rights Holders; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; Consumers
3.Contributions to content funding	Content Producers; Online video aggregators; Internet Players; CE vendors
4.Agreements between CDNs, online video service providers and ISPs	ISPs; CDNs; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors
5.Regulated prioritisation of content delivery	ISPs; Mobile operators; CDNs; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
6.Regulated content aggregation and recommendation	Rights Holders; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
7.Access to online video services independently of where services are established	Rights Holders; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
8.Simplification of content licencing processes	Content Producers; Rights Holders; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
9.Access to cultural heritage content	Content Producers; Rights Holders; Distributors; Consumers
10.Privacy regulation	Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
Technological triggers	
1.DRM technologies converge into a few standards	Rights Holders; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Software Developers
2.DRM enforced at network level	ISPs; Mobile operators; CDNs; Pay-TV operators; CE Vendors
3.Streaming technologies converge into a few standards	Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Software Developers
4.Continuity of user activity across multiple screens	Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Software Developers; Consumers
5.Second-screen apps interconnected with online video services	Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
6.Immersive real-time experience for online video consumption	Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
7.Personalised/context-aware experience and recommendations	Content Producers; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Consumers
8.Video content cached in the network	ISPs; Mobile operators; CDNs; Pay-TV operators; CE Vendors
9.Customisable quality of service and experience for real time and low delay video transmissions	ISPs; Mobile operators; CDNs; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; Distributors; CE vendors
10.Seamless mobility between heterogeneous networks	ISPs; Mobile operators; Consumers
11.4K and 8K standards/tech widely in the market	Rights Holders; Content Producers; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors; Software Developers; Consumers
Business triggers	
1.Legal services compete with illegal services	Rights Holders; Content Producers; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors
2.ISPs, pay-TV providers, mobile operators launch their online video services versus establish partnerships with other providers	ISPs; Mobile operators; Pay-TV operators; Distributors; Online video aggregators; Internet Players; Broadcasters; CE vendors; Consumers
3.Personalised ads tailored to consumer preferences and context	Ad brokers; Advertisers; Distributors; Online video aggregators; Internet Players; Broadcasters; Pay-TV operators; CE vendors; Consumers
4.Market adoption of proprietary versus open technologies	Distributors; Online video aggregators; Internet Players; Broadcasters; Pay-TV operators; CE vendors; Consumers
5.New models of content creation funding	Rights Holders; Content Producers; Distributors
6.Content release windows will adapt as online video services' original content production expands	Rights Holders; Content Producers; Distributors; Online video aggregators; Internet Players; Broadcasters; Pay-TV operators; CE vendors; Consumers
7.New metrics and tools for online video services audience measurement	Content Producers; Online video aggregators; Internet Players; Broadcasters; Pay-TV operators; CE vendors; Consumers
Social triggers	
1.Users favour legal video consumption	Rights Holders; Content Producers; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors
2.High acceptance rate of online video services	ISPs; Mobile operators; CDNs; Rights Holders; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors
3.Users favour a personalised experience	Content Producers; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors
4.Live versus on demand content consumption	Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors
5.Physical ownership versus digital ownership versus online streaming	Rights Holders; Distributors; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters; CE vendors
6.High penetration of various types of devices	CE vendors; Software Developers; Appstores; Online video aggregators; Internet Players; Pay-TV operators; Broadcasters

Appendix C

Place-shifting: Taking your Live TV with You

Place-shifting devices and services retransmit the live feed of over-the-air (OTA), cable or satellite television across the Internet to be viewed anywhere, anytime. This solution, for which Slingbox is the most popular device, captures the TV service at the viewer's home and makes it available for viewing almost simultaneously at another location in a TV, computer or mobile device. Content can thus be watched either at home on another TV or on a mobile device, as well as away from home while commuting home or travelling abroad. While for the services previously described the viewer uses one broadband connection to consume video, for place-shifting two broadband connections — one at the source and one at the receiver — are required.

Place-shifting has been the target of public controversy for threatening creative copyright holders' abilities to fully enjoy the benefit of their property rights and has more recently raised concerns among broadcasters over piracy, unfair competition and copyright infringement. While most literature on place-shifting is focused on the Slingbox and potential copyright infringement (Russell, 2008; Sathyanarayana, 2007; Schnaps, 2007; Talar, 2007), this section intends to extend existing literature by analysing the market structure and control strategies among partners in the value network. Place-shifting is yet another service putting stress on operators' networks — video content is uploaded at the source typically through a fixed broadband connection and downloaded at the receiver either through a fixed broadband or a mobile broadband connection depending on location. Once these services gain more popularity, will network operators find this type of usage acceptable (especially on the mobile end)? ISPs and network operators have been fighting with broadcasters and media players to get them cover the costs for the capacity needed to deliver on-demand video services and video-sharing website services to end viewers (Wilson, 2008; France-Presse, 2013). Since place-shifting requires two broadband connections, will network operators also become strong opponents of these type of services for clogging their networks? Or will they see new opportunities for additional sources of revenue, for selling high-end data plans and for partnerships to place-shift vertically integrated IPTV services? So far, mainly broadcasters and content providers have raised their voices against place-shifting and mostly on the grounds of copyright violation and unfair competition.

In the next section, a definition of place-shifting will be presented. The following section describes and compare place-shifting solutions and present a taxonomy addressing type of service (hardware, cloud or software-based), geographical use and business model. Next, a brief overview of control strategies taken up by players with regard to copyright infringement, patent infringement and acquisitions in order to limit peers' market expansion and block services will be provided. In the final section, conclusions are provided. This work benefits from a literature review on the topic, still scarce at the moment, and which is mostly based on copyright law and the U.S. market. In addition, further analysis of each service has been performed by gathering information available on corporate websites, users' and enthusiasts' fora, news websites, press releases and case laws.

C.1 From Time-shifting to Place-shifting?

Place-shifting can be defined in contrast to time-shifting. The VCR, and later the PVR/DVR (Personal/Digital Video Recorder), revolutionised the way people watch television, as they allow recording a program when it is broadcasted for later viewing, at a convenient time. This is what is behind time-shifting – shifting content in time, for watching at a more convenient moment. In opposition, place-shifting aims at shifting content while it is being broadcasted to other places, being regions and countries, but also to other devices than the television set.

Many definitions of place-shifting can be found in literature (Schnaps, 2007; Talar, 2007; Montpetit et al., 2010; Rivers, 2007). Nevertheless, the analysis here presented is driven by the functional and basic definition given by Russell (2008), encompasing more market-oriented definitions (SlingMedia, 2013): "Placeshifting is the transfer of a multimedia signal from a source to a receiver over a computer network simultaneously with the signal's generation at the source.". Russel goes on defining a source as "anything that generates a multimedia signal—often a cable television box or satellite receiver, but also a computer, DVR, or other device, and multiple sources may be connected at once" and a receiver as similarly varied and including "software running on personal computers, laptops, cell phones, and video game consoles, or hardware designed specifically to receive placeshifted signals" (Russell, 2008).

In its definition, Russell does not explicitly explain "computer network". However, it can be implicitly inferred from his article that what is at stake is the Internet and not the home network in a household. While considering the Internet, this definition excludes devices such as TiVo Premiere DVR or Elgato's EyeTV, which only allow content to be place-shifted to devices connected to the home network. Transferring the multimedia signal simultaneously with the signal's generation at the source also precludes devices such as Apple TV, Roku or TiVo Stream. These type of devices, commonly referred to as digital media receiver or digital media hub, only play saved content available in platforms such as iTunes, Netflix or Hulu or available in devices (PCs, storage devices) in the home network. Therefore, these devices are inherently different, since they do not forward the signal simultaneously with its generation at the source, but play (multiple times) a signal that is stored elsewhere.

Place-shifting allows viewers to watch their home TV anywhere. Content can thus be watched either at home on another TV or on a mobile device, as well as away from home, while commuting home, in a vacation home or when travelling abroad. Place-shifting has also become popular among ex-pats wanting to follow their home news and among sports fans in the U.S.. In fact, Sling Media founders have invented Slingbox out of frustration, as they could not watch their home baseball team while on business trips. In the U.S., professional sports leagues hold proximity controls, which enable them to restrict the distribution of content by region and broadcast time (Bechis, 2009).

Place-shifting solutions are largely based on hardware, but other solutions based on cloud services or software plus a simple TV tuner also exist. Figure C.1 depicts a generic setting for a hardware solution. The place-shifting device sits between the set-top box or antenna that delivers TV content and the broadband access to the Internet. The video content is transmitted over the

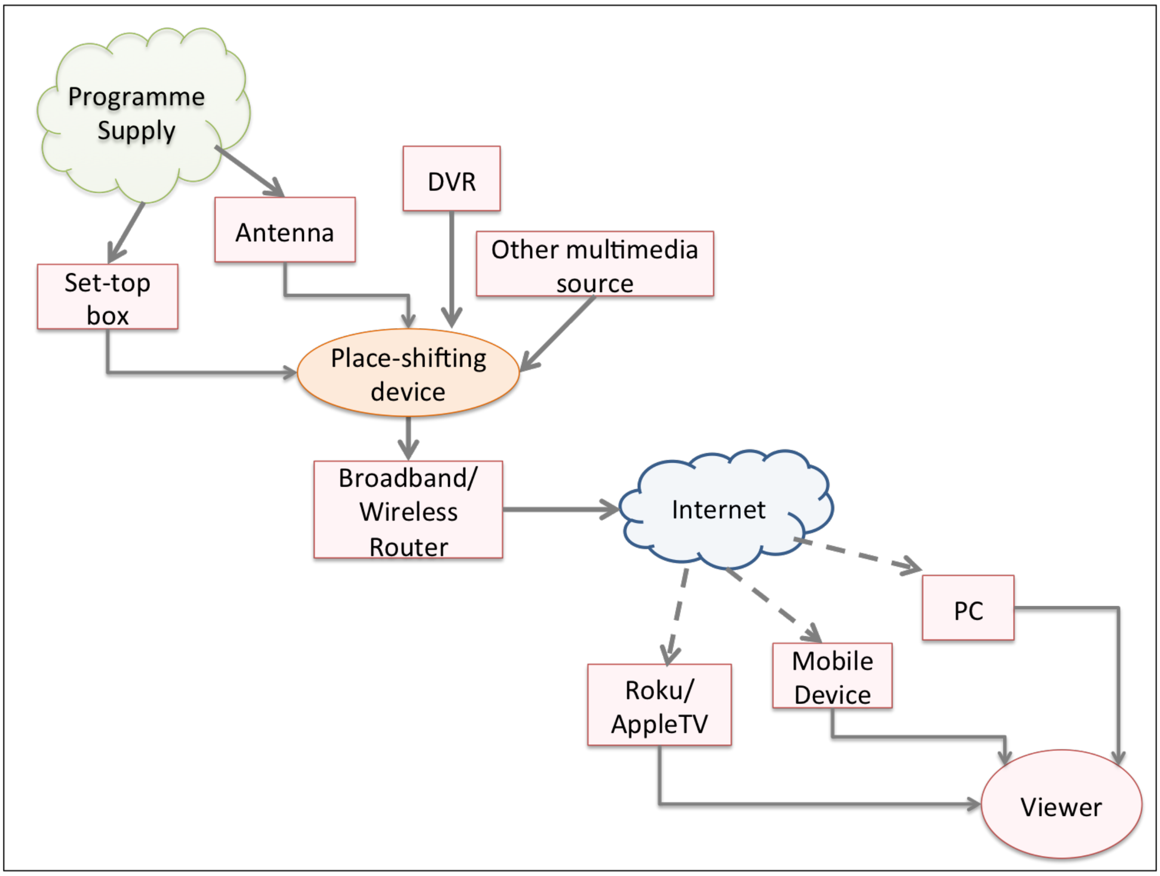


Figure C.1: Generic representation of a hardware-based place-shifting solution.

Internet, allowing a viewer to watch the transmitted content remotely on an Internet-enabled device.

C.2 An Emergent and Fragmented Market

The previous section presented a definition of place-shifting. This section will overview a set of place-shifting solutions and conclude with a brief taxonomy of solutions currently in the market. The list of solutions does not intend to be exhaustive, but just serve as support to illustrate the different market options. For this reason, solutions that are currently no longer on the market, such as Sony LocationFree and SageTV, will not be covered.

Literature on place-shifting mostly focus on a single device – Sling Media's Slingbox. Marketed since 2005, this device gained popularity across the globe, not only because of its sales rate, but also due to controversial issues around partnerships, copyrights, patent infringements, and even "unauthorised" business models. The Slingbox is a device which connects both to a video source (e.g. DTT antenna, cable/satellite/IPTV set-top box, DVR, Blu-ray player) and to an Internet connection through a home network router. The Slingbox receives the video signal from the source and then transmits it over the home network and out across the Internet, allowing a Slingbox owner to view the transmitted content remotely on an Internet-enabled device (computers, smartphones, tablets, etc.). A user needs to use SlingPlayer client software on any viewing device or use the web-based SlingPlayer software, in order to remotely watch live and recorded video content. SlingPlayer provides additional features such as remotely controlling channels, pause, fast-forward or rewind, and allows the users to set up DVR recordings with an on-screen virtual remote control. Furthermore, SlingPlayer has been incorporated in connected devices (such as WD TV Media Player, Sony Internet Player with Google TV and Netgear NeoTV) allowing the viewer to watch content in another TV. To start using Slingbox, a consumer needs a one-time investment in a box and in SlingPlayer for a mobile device (iPhone, iPad, Android smartphones and tablets, Windows smartphones and Kindle Fire are all supported) or, alternatively, use SlingPlayer's free Web version.

Another place-shifting device, TV2Me, was introduced in the market in 2004, earlier than Slingbox. The setup of the device (connection to a cable or satellite box, an Internet connection and, optionally, a DVR) is very similar to Slingbox, but TV2Me claims to deliver very high-quality video. TV2Me does not require any additional installation or purchase of a player on the receiving device.

Belkin @TV Plus device was released in mid 2012. It works much the same way as Slingbox, as it is a box dedicated to place-shift signals inside the home network and over the Internet. Similarly to Slingbox, an application is required to watch live and recorded content on mobile devices. Currently there is a one-time fee to download the application to smartphones (iPhone and Android), while it is free for tablets and PC and Mac computers. A clear difference over Slingbox is the ability to record live TV using @TV Plus application. Content can be stored in the device (mobile or computer) to be watched once the consumer is offline.

Monsoon Multimedia has been commercialising place-shifting devices, first under the brand HAVA and since mid-2010, under the brand Vulkano. Vulkano devices present different levels of DVR functionality and storage space for recordings. Monsoon also makes clear on the website that a second Vulkano device is required if the place-shifted signals are to be viewed in another TV. Similarly to the devices previously described, Vulkano devices are able to place-shift signals inside the home and over the Internet. Likewise, an application is required to watch content on computers (free) and mobile devices (paid). The application for mobile devices allows users to record place-shifted content to mobile device's internal storage for offline viewing.

The devices described so far, have as sole purpose to place-shift signals. Simple.TV is another device that can place-shift content, although it is primarily a networked TV tuner. In other words, it captures free-to-air broadcast TV through a connected HDTV antenna and streams TV content to wireless devices. Unlike previously described devices, cable or satellite boxes cannot be connected to Simple.TV. Moreover, Simple.TV does not come with internal storage. The consumer needs to attach his/her own external hard-drive to be able to stream and record channels content on the device side. Live and recorded content can be watched on a computer or mobile device in the home network with a browser or specific app or on a TV with Roku media streamer or Apple TV. A premium subscription allows watching content over the Internet for up to 5 users, scheduling recordings automatically and an EPG. Simple.TV has gathered financial support to launch in 2012 from more than 1000 backers through the famous crowdfunding platform Kickstarter.

The solutions discussed above require the consumer to have one of these devices permanently connected to a pay-TV set-top box or an antenna. In other words, this means that an American expat currently living in the U.K. would need to have a house in the U.S. where these two devices, the place-shifting device and the set-top box/antenna, would be connected. The following services do not require any box at the consumer's premises. The TV package or over-the-air TV antenna are "plugged-in" to a cloud place-shifting service at the provider's premises. Therefore, the consumer is not required to keep any of these devices in a physical location wherein the signals are being captured.

Launched at the end of 2012, NimbleTV is a place-shifting service that does not require a box. It is currently only available in New York City, U.S. NimbleTV offers both free and two premium subscription plans. The free plan is limited to free-to-air channels, while the premium plans allow a consumer to link an existing cable plan or a new cable plan to NimbleTV to be watched everywhere. In addition, premium subscriptions also allow recording functionalities. Therefore, NimbleTV captures content (provided by the cable channels) in the cloud and delivers it over the Internet to the subscriber. To watch live content only a browser is required, enabling the support of computers, mobile devices and connected TVs. Apple TV and Roku are also supported devices to stream to TV sets.

Aereo was recently launched in March 2012 and was promptly sued for copyright infringement by broadcasters. Currently only available in selected U.S. cities, Aereo hosts in the cloud tiny HDTV antennas, one for each of its customers. Therefore, Aereo only offers over-the-air live TV channels and local channels. In addition, these antennas are connected to DVRs, letting users to schedule recordings for later viewing. Aereo is offered with a monthly subscription and works with all popular web browsers and does not require a specific application for mobile devices. It claims it restricts viewing to a geographical area covering the client's credit card billing address, so that in practice a viewer would only have access to the same TV channels as if the antenna would be placed at the viewer's home rooftop. For remote viewing, Aereo claims it uses location services to limit viewing over the Internet to the same home coverage area.

Table C.1 presents a brief taxonomy of the place-shifting solutions described so far. Even though this classification mostly concerns TV signal place-shifting, other multimedia signals (e.g. DVR, game consoles, Blu-ray) can also be place-shifted by most of these solutions. Most hardware-based solutions are versatile in what concerns the type of TV service that can be place-shifted and require from the consumer the investment on the hardware itself and an application for a mobile device. Furthermore, most hardware-based solutions are compatible with any IPTV, cable and satellite set-top box, which means they can be marketed globally and place-shift signals received in one country for viewing in another country. In a scenario in which the consumer is an expat, the requirement for a physical location can be considered one of the main drawbacks of the hardware-based solutions. This drawback is at the origin of a new business scenario – hosting of place-shifting devices. Several place-shifting hosting providers have emerged, which host a place-shifting device in the country where the content is captured and facilitate the subscription of a TV package, normally a cable or satellite subscription. This functionality may originate cross-country content licensing issues in the relationship between pay-TV operators/broadcasters and content producers.

Cloud-based solutions are currently less flexible with regard to geographical location (currently only available in the U.S.) and TV service to be place-shifted. Their setup is however more simple and does not require the consumer to keep a physical location to hook-up the TV service.

Most solutions only allow one remote viewer at a time, while others raise the limit to 5 simultaneous viewers over the Internet or at home. Recording features are not present in the early launched devices (Slingbox, TV2Me), but are now the trend in recently launched hardware and cloud-based solutions. While with some solutions content is only recorded in the place-shifting device or source for later viewing in the receiver, other solutions allow receivers (e.g. mobile application) to record content directly to mobile devices. Among the solutions that require an application to remotely watch place-shifted content, Slingbox seems to dominate in the number of downloads[1] for smartphones and tablets (iOS and Android).

	TV service	Source	Receiver	Recording function[1]	No. of viewers[2]	Business Model	Mobile App Downloads
Hardware-based							
Slingbox	IPTV, Cable, Satellite, OTA[3]	Anywhere	Anywhere	No	1	Hardware + Application	1058.5K
TV2Me	IPTV, Cable, Satellite	Anywhere	Anywhere	No	N/A[4]	Hardware	App not required
@TV Plus	IPTV, Cable, Satellite	Anywhere	Anywhere	On receiver side	1 remote (or various at home)	Hardware + Application	64K
Vulkano	IPTV, Cable, Satellite	Anywhere	Anywhere	On device and receiver side	1	Hardware + Application	266K
Simple.TV	OTA or basic digital cable	U.S., Canada and UK	Anywhere [5]	On device side	5	Hardware + Subscription	38.9K
Cloud-based							
NimbleTV	Cable, Satellite	U.S. (to expand)	Anywhere	On the cloud	1	Subscription + TV Package	App not required
Aereo	OTA	Selected U.S. cities	Selected U.S. cities	On the cloud	1	Subscription	App not required

[1] Specifies where content is saved.
[2] Number of simultaneous viewers.
[3] PRO-HD version only.
[4] Information not found.
[5] Anywhere with subscription. Home network otherwise.

Table C.1: Taxonomy of place-shifting solutions.

This section overviewed a number of place-shifting solutions currently in the market. This market is still in its infancy and very fragmented, while there is no single solution that is comparable to another solution, both in delivered features and business models. There are still many new

[1] Number of downloads gathered and calculated through www.xyo.net (as of June 2014).

companies entering the market with diverse business models, geographical scope and technologies. Considering Utterback and Abernathy (1975) dominant design's theory, one can conclude that place-shifting is still in the emerging stage. There is still a wide variety of companies trying to establish their own technology, while considerable uncertainty still exists regarding which service features attract most to consumers and which technology will be best placed to provide such features. In addition, business model innovation is particularly powerful and potentially disruptive in this phase, but companies have not yet found a common business model for the different types of place-shifting technologies. On the one hand, hardware-based solutions can place-shift TV signals from anywhere in the world to any other location around the world, provided there is an OTA antenna plugged or TV package subscription at the source's location. Nevertheless, these do not seem to fit mass utilisation, but tech-savvy users instead. On the other hand, cloud-based solutions seem easier to setup and do not require any expert knowledge. However they are currently confined to the U.S. market. As will be described in the next section, companies have however started pursuing strategies related to intellectual property (IP) protection in order to preserve own technologies and establish business models. More than one simultaneous remote viewer and recording features are among the characteristics that are deemed to be the target of disputes between place-shifting providers and pay-TV operators, broadcasters and content producers on the grounds of copyright and licence agreements violations and may delay technology growth.

C.3 Stakeholders' Strategies

This section presents stakeholders' strategies exerted by players on its direct competitors or among value-network players. The first case is related to control of intellectual property and how a player is using it to put pressure on direct competitors and prevent them from marketing their competing products. As place-shifting services intersect media services and ecosystem, the following case illustrates how broadcasters position themselves as gatekeepers of media content and try to prevent others from using their content on the grounds of copyright infringement and unfair competition. The last case presents an attempt to control and stop other players from giving other uses to a technology.

C.3.1 Intellectual Property Infringement

With respect to patent infringment, Sling Media filed U.S. complaints against Belkin International, Inc., Monsoon Multimedia, Inc. and C2 Microsystems, Inc. alleging these companies unlawfully import and sell products that infringe six patents related to place-shifting and/or display replication functionality. In this case, Sling Media strategy seems to intentionally damage competitors' image as well as prevent Belkin and Monsoon from marketing Slingbox's competing products. Sling Media requested the court to halt "the importation, sale, offer for sale, marketing, advertising, or solicitation of customers of electronic devices" having place-shifting functionalities that infringe the referred patents. Before the court has issued a decision, Sling Media has announced that it has agreed to drop patent accusations against Belkin, without giving further details on the settlement (Baumgartner, 2013).

Sling Media is distorting intellectual property processes as it is documented in literature. As Melody (2013) describes, it is now common practice that intellectual property rights (IPR) are obtained not to develop a technology but rather to prevent competitors to develop similar technologies. Strategic delays are induced on competitors' technologies by establishing potential claims while at the same time promoting one's own technology.

C.3.2 Copyright infringement

In recent years, broadcasters pursued several battles with pay-TV operators fighting for retransmissions fees, but also for a gatekeeper position, once they realised they were loosing their direct relationship with the customer to pay-TV operators. With the current hype of online video services, broadcasters turned their attention to these new providers, while also trying to position themselves in the business ecosystem. At stake are litigations about whether streaming of broadcast television content violates copyright laws and whether this new type of online video providers would need a licence to broadcast TV and/or to pay retransmission fees to broadcasters. Content producers are as well positioned against these services and argue for compensations for retransmitting their content.

Before Aereo started operating, TV broadcasters Twentieth Century Fox, Fox Television, Univision, PBS, and two local New York TV stations filed suit in March 2012 against Aereo for copyright violations due to unauthorised rebroadcast and reproductions, as well as unfair competition. Broadcasters raised concerns that Aereo would be competing with broadcasters'

Internet platforms. A second suit, also for copyright infringement, was filed by ABC, Disney, CBS, NBCUniversal, Universal Network Television, and Telemundo. Both suits intended to block Aereo from streaming. In essence, broadcasters were worried that Aereo was gaining access to content for free and undermining their business model. As broadcasters and content providers' business model strongly relies on licensing content to pay-TV operators, Aereo was seen as getting away with their content for free. Broadcasters seemed also to be afraid of losing bargaining power with operators and achieving worst licensing deals, as operators would probably refer to Aereo as a free-rider. In addition, broadcasters also suggested that Aereo could change content, omit content or add its own ads on top of the content, and thus profit from something it did not own rights.

On the other side of the suit, Aereo claimed that consumers were legally entitled to access broadcast television via an antenna and that was what Aereo was providing to each customer – a tiny antenna installed in a rack together with other customers' antennas. Customers could then access their own signal through an Internet-enabled device. In addition, with regard to the recording functionality, Aereo argued that consumers were also entitled to record television content for personal use and this functionality was not different from recording in the cloud and accessing through the Internet.

Aereo did win the two court cases and continues operating and expanding to more cities[2]. The two judges found the service was legal on the grounds that each antenna functions independently and that transmissions of unique copies of broadcast television programs created at its user's requests and transmitted while the programs are still airing on broadcast television are not considered "public performances". Regarding DVR functionalities, these were also not considered copyright infringement based on a decision of a previous battle between content producers and Cablevision, which established the legality of Cablevision's Remote Storage DVR service.

When launched in the U.S., Slingbox was particularly appealing to sports fans since it allowed watching sports events the user would not be allowed to in its region, thus circumventing geographical boundaries written into broadcast rights deals. U.S. sports leagues hold proximity controls, which enable them to restrict the distribution of content by region and broadcast time. However, rights holders have reacted differently to Slingbox technology. On one side, MLB was one of the

[2] This work reports to current status in June 2013. Meanwhile Aereo has been shut down after the U.S. Supreme Court ruled against Aereo in June 2014. The court decision considered the service unlawful, by redistributing third party television content without a licence or consent from broadcasters and content creators, while making considerable profit from charging a subscription fee to end-users

fiercest opponents and even tried, albeit unsuccessfully, to obtain licensing fees from Sling Media (Yakovee and Crosner, 2007). On the other side, National Hockey League (NHL) was one of the first content producers to partner with Sling Media to offer content through the platform Clip+Sling.

These kind of litigations intend to deter new players to enter the media ecosystem and launch new services, while also securing producers and broadcasters positions as gatekeepers of digital content. While producers and broadcasters are trying to build a role in the online video ecosystem through their own streaming portals, catch-up and VOD services, they are also on the lookout for new sources of revenue to fund digital production and counteract losses in advertising revenues. Fearing losing their power position, producers and broadcasters might choose to impose new (or old) copyright management models on new entrants and gather the corresponding revenues, or let entrants starve of content in order to eliminate potential competitors.

C.3.3 Downstream Players

Around Slingbox solutions, a new business model has emerged – hosting Slingbox boxes for a fee – comparable to the well-known business scenario of servers' hosting. In place-shifting's case this is however not enough to allow a viewer to watch place-shifted content. Place-shifting hosting providers thus also offer subscription options for cable or satellite packages together with the hosting service. The TV packages are the input signal to the hosted Slingbox. This scenario is considered particularly convenient for viewers that do not own a physical location at the country for which they are interested in place-shifting TV.

There seems to exist a market opportunity for hosting, since the number of providers has grown and spread all over world from Taiwan to U.S., United Kingdom and Portugal. Most hosting providers only offer Slingbox hosting while some have already started to host Vulkano as well. The majority of the services require a (new) subscription of a cable or satellite TV package and a setup fee for connecting devices, while some offer the possibility of using customer's existing TV contract. Prices vary according to TV package, number of channels and type of subscription, monthly or annually.

While hosting services seem to be popular among consumers, Sling Media showed several times that it was not pleased with these services. Sling Media accused hosting providers of violating its licence agreement, but has in fact not taken any legal action against these providers (DailyBeast, 2008). It has only tried to dissuade consumers to engage in these practices by banning all hosting posts on its official message boards and warning customers that this use is illegal.

In this case, Sling Media was pursuing a control strategy by attempting to prevent other players from giving other uses to its technology. At the eyes of its End User Licence Agreement, which says that users cannot lease, lend or rent, consumers are the only ones infringing the rules. Therefore, it appears Sling Media cannot do much against stopping hosting providers. And in fact, it is not clear if Sling Media would profit from taking this path further on. At the end of the day, hosting providers are helping popularising Slingbox among its competitors and are increasing Sling Media's sales rate.

C.4 Conclusion

This work extended current literature on place-shifting by overviewing a number of place-shifting solutions, presenting a brief taxonomy of solutions currently in the market and describing control strategies among partners in the value network.

While the media industry is slowly becoming aware of place-shifting solutions and is trying not to lose power over its content, the place-shifting market is still very fragmented regarding available features and business models. Although Slingbox appears to be the dominant platform, it can be concluded there is still a wide variety of companies trying to establish their own technology and there is no dominant design yet that characterises how this technology will unfold. Slingbox in particular requires technical knowledge to set it up and is not considered a simple solution for mass utilisation. However, place-shifting hosting providers are providing the means to overcome some of the technicalities, thus paving the way for mass adoption. Cloud-oriented solutions also remove the need for technical knowledge and have called for public and media industry attention.

Slingbox has benefited from being one of the first affordable devices in the market, but is now being threatened by the solutions that have been launched in the last couple of years. It is pursuing a strategy of preventing competitors to market their products and damaging their image on the basis of patent infringement claims.

A number of questions that should also be analysed in the future remain however unanswered: Will place-shifting solutions prevail as the solution that allows viewers to have access to content anywhere anytime for a reasonable price? Or will broadcasters and pay-TV operators finally take strong steps to implement TV-everywhere platforms? Would this be made easier by partnerships for technology sharing between media partners and place-shifting providers? Regarding business models, is place-shifting really challenging media players' revenues or are they not seeing the whole picture as it happened with the VCR and DVR? As pay-TV operators argue that place-shifting usurps their exclusive rights to broadcast and content producers fear that this technology is undermining their licensing revenues, would this call for changes in cross-country/global licensing and pricing schemes? And, finally, if place-shifting is able to compete with TV-everywhere platforms in the future, will network operators try to cut off place-shifting services (especially hardware-based) or try to make a profit from specific high-end data plans?

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